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SURFACE-DUCT SONAR MEASUREMENTS (SUDS I - 1972) OCEANOGRAPHIC M--ETC(U)
JAN 76 E R ANDERSON

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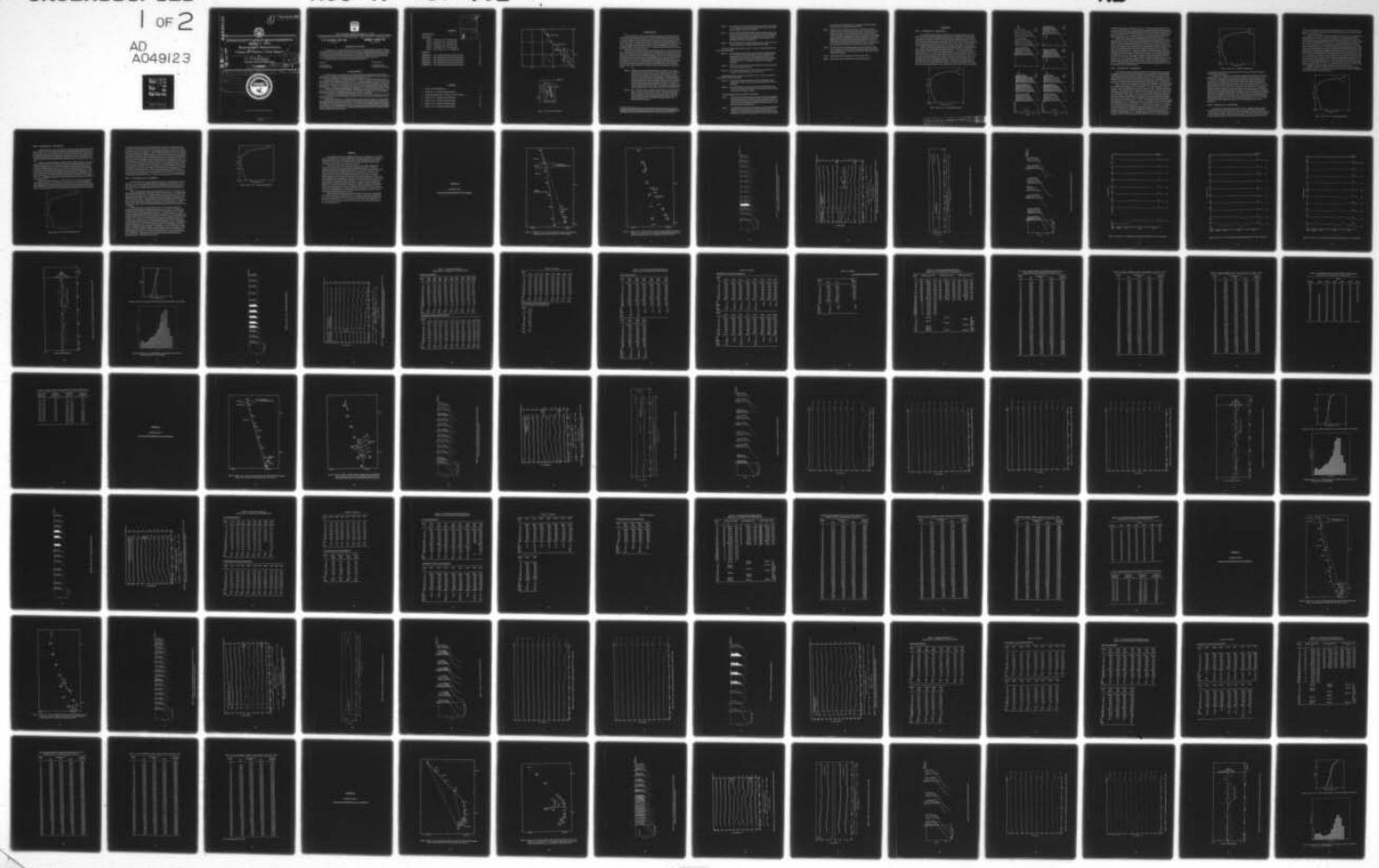

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SURFACE-DUCT SONAR MEASUREMENTS (SUDS I - 1972)

Oceanographic Measurements.

Volume IV: Station 3 Data Report.

by

(10) E. R. Anderson

Undersea Sciences Department

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AN ACTIVITY OF THE NAVAL MATERIAL COMMAND

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Technical Director

ADMINISTRATIVE STATEMENT

During February 1972 the Naval Undersea Center conducted a series of 18 propagation loss experiments in three deep-water areas off the coast of California. These experiments are known as the SUrface Duct Sonar Measurements (SUDS I – 1972). This work was originally supported by the then Naval Ships Systems Command, Sonar Technology Division, PMS-302-4 and partly supported by the Office of Naval Research, code 102-OSC. The preparation of this report began in April 1973 under the sponsorship of the Naval Sea Systems Command, code 06H1-4, problem SF 52-552-602, task 19344. This report covers work from March 1971 to January 1976 and was approved for publication in March 1976.

Technical reviewers for this report were M. A. Pedersen and P. G. Hansen.

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ACKNOWLEDGMENTS

The SUDS I program was a coordinated and cooperative effort involving personnel from the Undersea Sciences Department and the Undersea Surveillance Department. Also participating in the oceanographic measurement program were personnel from the Lockheed Ocean Laboratory (Lockheed Missiles and Space Co., Inc.).

The Principal Investigator for the SUDS experiments was J. Cummins. P. G. Hansen and K. W. Nelson were the Senior Scientists for the oceanographic measurements program. D. P. Hamm was the Principal Investigator for the Lockheed Ocean Laboratory. The Lockheed Ocean Laboratory, with L. P. Coates as Program Manager, constructed the Teletherm buoy system, operated the system at sea, and provided the initial reduction of the data. The following assisted in a consulting and planning capacity: E. R. Anderson, P. A. Barakos, O. S. Lee, and W. F. Potter. Assisting in the preliminary data reduction and analysis was J. L. Thompson, an exchange scientists from Royal Australian Navy Research Laboratory, Sidney, Australia.

H. P. Bucker was the Scientist-in-Charge aboard the *DeSteiguer*, D. E. Good, the Scientist-in-Charge aboard the *Lee*, and P. A. Hanson, the Scientist-in-Charge aboard the *Cape*. Assisting with the oceanographic measurements at sea were: A. E. Diamond, H. L. Haskall, C. T. Smallenberger, and W. M. Woods. The assistance of the officers and men of the *DeSteiguer*, *Lee*, and *Cape* in making the oceanographic measurements program a success is acknowledged.

C. L. Barker and C. D. Curtis calibrated the Teletherm buoy sensors, K. W. Nelson, S. L. Speidel, and G. L. Crutcher assisted in the data reduction and computer aspects of the work, and O. S. Lee supervised the spectral analysis of the Wave-rider buoy measurements.

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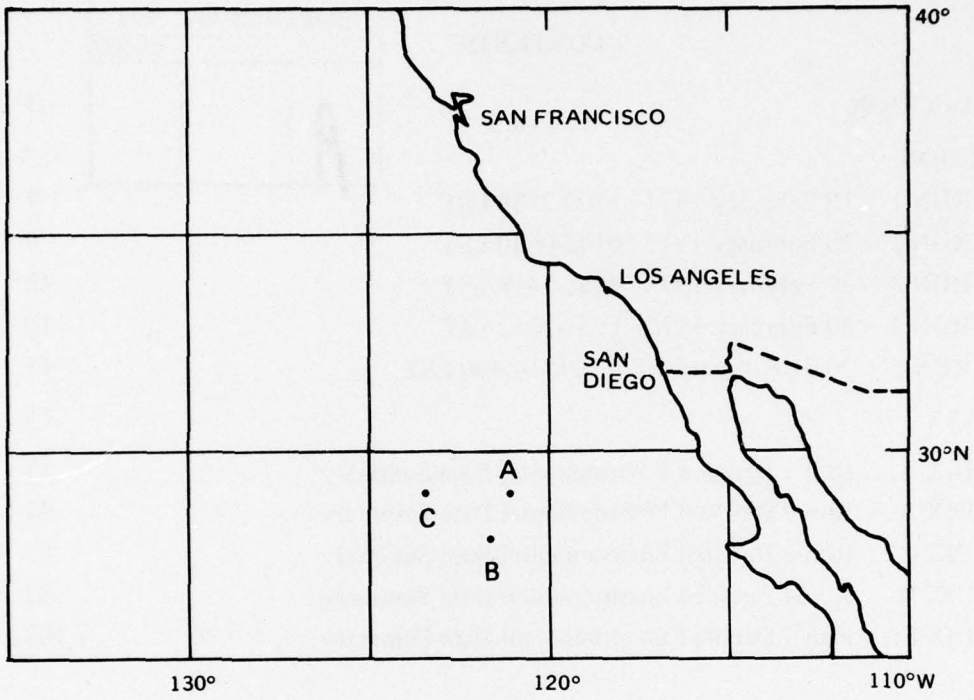
CONTENTS

FIGURES



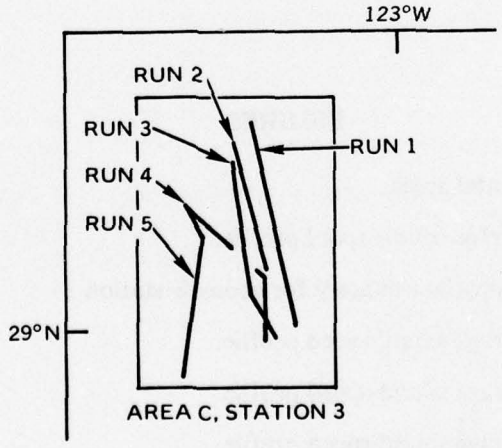


Figure 1. Location of experimental areas.

INTRODUCTION

This is the fourth in a series of five volumes describing the environmental measurements made during the SUDS I experiments. Volume I discusses the instrumentation used to make the required environmental measurements, the data reduction procedures, an accuracy analysis of the final measurements, and the reconstruction of the experimental track charts. This volume is a detailed report of the environmental measurements applicable to the acoustic experiments conducted during station 3, where five propagation loss runs were completed. Figure 1 shows the location of the experiments and the track of the source ship. Source ship speed was 3 knots for all runs.

The detailed environmental data for each propagation loss run are summarized in the form of charts, plots, and tables in the appendices. Each appendix presents the same kind of data in the same sequence for all propagation loss runs. Additions and omissions are made as appropriate for the run described. Thus the first figure (A-1, B-1, etc.) is a chart showing the locations of source and receiver ships, selected propagation paths, and wind velocity. The second figure (A-2, B-2, etc.) is a chart showing the locations of XBT, thermistor chain, and Teletherm buoy measurements used to determine the distribution of sound speed and the locations of surface-wave measurements made by the Waverider buoy used to determine surface roughness. The balance of the figures and tables in the appendices are organized as follows:

Figure 3. Plot of selected sound-speed profiles from the surface to 250 m taken along the track of the source ship*. These are derived from the XBT and thermistor chain profiles whose locations are shown in Fig. 2. These profiles are used to identify any unusual changes in the horizontal distribution of sound speed, particularly with regard to vertical profile shape. These plots show sound speed versus depth, with the 1503 m/sec isospeed abscissa being located at the proper distance along the source ship track. The area containing sound speeds higher than 1503 m/sec is shaded. If a sound-speed profile boundary is crossed, the transition sound-speed profile shapes are shaded darker. The number is the time in local standard time.

Figure 4. Plot of thermistor chain temperature measurements at 10 selected depths about 25 m apart from the surface to 242 m. Abscissas showing time, distance along source track, and acoustic range are also included. These plots are used to reveal any important horizontal temperature changes present during the acoustic experiments that might influence the experimental measurements.

In this paper only computed sound speeds are reported. The computed sound speeds are obtained from Anderson's sound-speed equation (Naval Undersea Research and Development Center, NUC TP 243, Sound Speed in Seawater as a Function of Realistic Temperature-Salinity-Pressure Domains, by E. R. Anderson, August 1971). Discussions of sound-speed distributions present during the propagation loss measurements are based on the computed sound speeds.

Figure 5. Plot of thermistor chain temperature measurements at the source depth or at two depths, 6 m apart, bracketing the source depth. Format and purpose of plots are the same as for Fig. 4.

Figure 6. Plot of sound-speed profiles derived from XBT, thermistor chain, and Teletherm buoy measurements. These profiles were made at identically the same time and are used to give a limited evaluation of the spatial change in profile shape present during the acoustic experiment. The plot format is the same as used in Fig. 3.

Figure 7. Plot of Teletherm buoy temperature measurements. Also shown are the average temperature and standard deviation at each depth.

The following figures are included for runs 1, 2, 4, and 5, in which Waverider buoy measurements were made:

Figure 8. Plot of Waverider buoy measurements showing the standard deviation of 3-min averages of the measurements. The point is plotted at the beginning of the 3-min interval. The dashed horizontal line is the standard deviation of the average of all measurements made during the propagation loss run. At the right is a histogram of the standard deviations.

Figure 9. Ogive of the standard deviation of the Waverider measurements for the 3-min averages presented in Fig. 8.

Figure 10. Plot of the standard deviation of the Waverider measurements as a function of wave period from 1.25 sec to 16.7 sec.

The following additional figures are included for runs 1, 2, and 3, in which sound-speed profile boundaries were crossed:

Figure 11. Expanded sound-speed profile plots derived from thermistor chain measurements. These are used to accurately establish the positions of boundaries.

Figure 12. Plots of thermistor chain measurements for 10 selected depths, about 6 m apart, to delineate the nature of the horizontal temperature change in the vicinity of boundary crossings.

The following tables are also included in each appendix:

Table 1. Tabulated values of temperature as a function of standard hydrographic depths and time of day for all XBT, thermistor chain, and Teletherm buoy measurements used in the sound-speed distribution analysis. Also tabulated are the isothermal layer depth (ILD), temperature (T) of the ILD, and surface layer depth (SLD).

Table 2. Tabulated values of sound speed as a function of standard hydrographic cast depths to 400 m for all converted XBT, thermistor chain, and Teletherm buoy temperature measurements used in the analysis. Also tabulated are the surface channel depth (SC), depressed channel depths

(DC), refractive channel depths (RC), and depths of the maxima below surface channels and depressed channels (MAX).

Table 3. Tabulated values of average sound speed at standard depths from the surface to 1500 m. Also included are the number of observations and the depths of the surface channel, depressed channels, refractive channels, sound-speed maxima, and the axis of minimum sound speed. The average values are obtained from thermistor chain measurements (0-250 m), XBT, hydrographic cast, and STD/SV measurements (300-400 m), and hydrographic casts and STD/SV measurements (500-1500 m). For runs 1, 2, and 3, three sound-speed profiles are tabulated for each run. These are the recommended sound speeds to be used from the surface to 1500 m.

Table 4. Tabulated values of the average temperature for each thermistor chain sensor. Shown are the sensor depth, the number of temperature measurements, the minimum and maximum recorded temperature, and the mean and standard deviation.

Table 5. Tabulated sea-surface roughness data used to prepare Fig. 8.

Table 6. Tabulated sea-surface roughness data used to prepare Fig. 10.

DISCUSSION

RUN 1 – 19 February 1972 1500-2130 LST

Plots of the individual sound-speed profiles, Fig. A-3, suggest that the source ship crossed a sound-speed profile transition volume between 1630 LST and 1730 LST. Figure A-11, a plot of 5-min-interval profiles, shows the crossing occurred between 1610 LST and 1640 LST over a distance of 2.2 kyd. The change is further confirmed by Fig. A-12, a plot of the thermistor chain temperature measurements from 79 m to 130 m. These measurements show a temperature change from 0.5°C to 1.0°C between 90 m and 124 m. This increase resulted in the elimination of the depressed channel present during the first part of the run.

Figure 2 is a plot of the profile 3 sound speeds listed in Table A-3. The details of the three profiles present during the run are presented in Fig. 3. None of the profiles has a surface channel. Profile 1 contains two depressed channels – a 75-m channel with the minimum sound speed at 17 m and a 33-m channel with the minimum sound speed at 110 m. Profile 3 has a 101-m depressed channel with minimum sound speed at 28 m. Profile 2 is not an average profile in the same sense that profiles 1 and 3 are, since the profile shapes in the transition water volume are gradually changing from profile 1 shape to profile 2 shape. In Fig. 3 the source and receiver depths are also shown. During this run, usable temperature measurements were recorded by Teletherm buoys 2, 5, and 6. The remainder of the buoys did not record usable measurements. From 1830 LST to 2000 LST the source ship paralleled

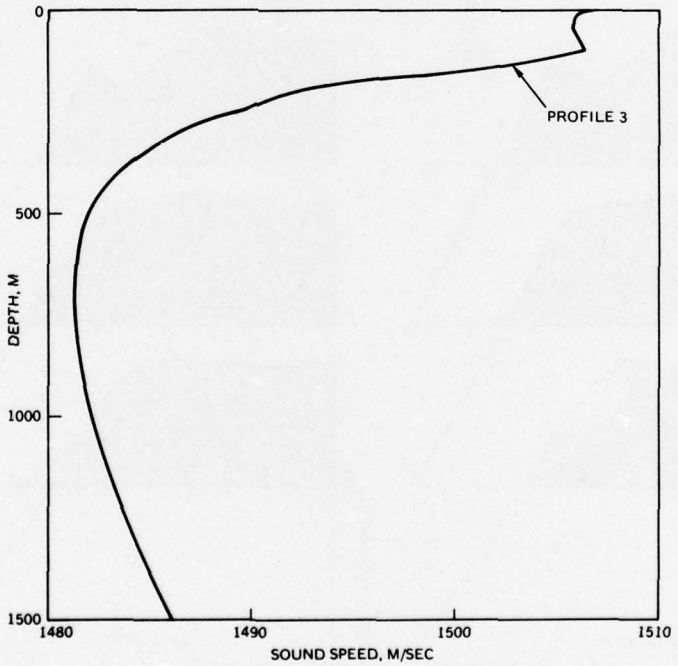


Figure 2. Station 3, run 1. Average sound-speed profile.

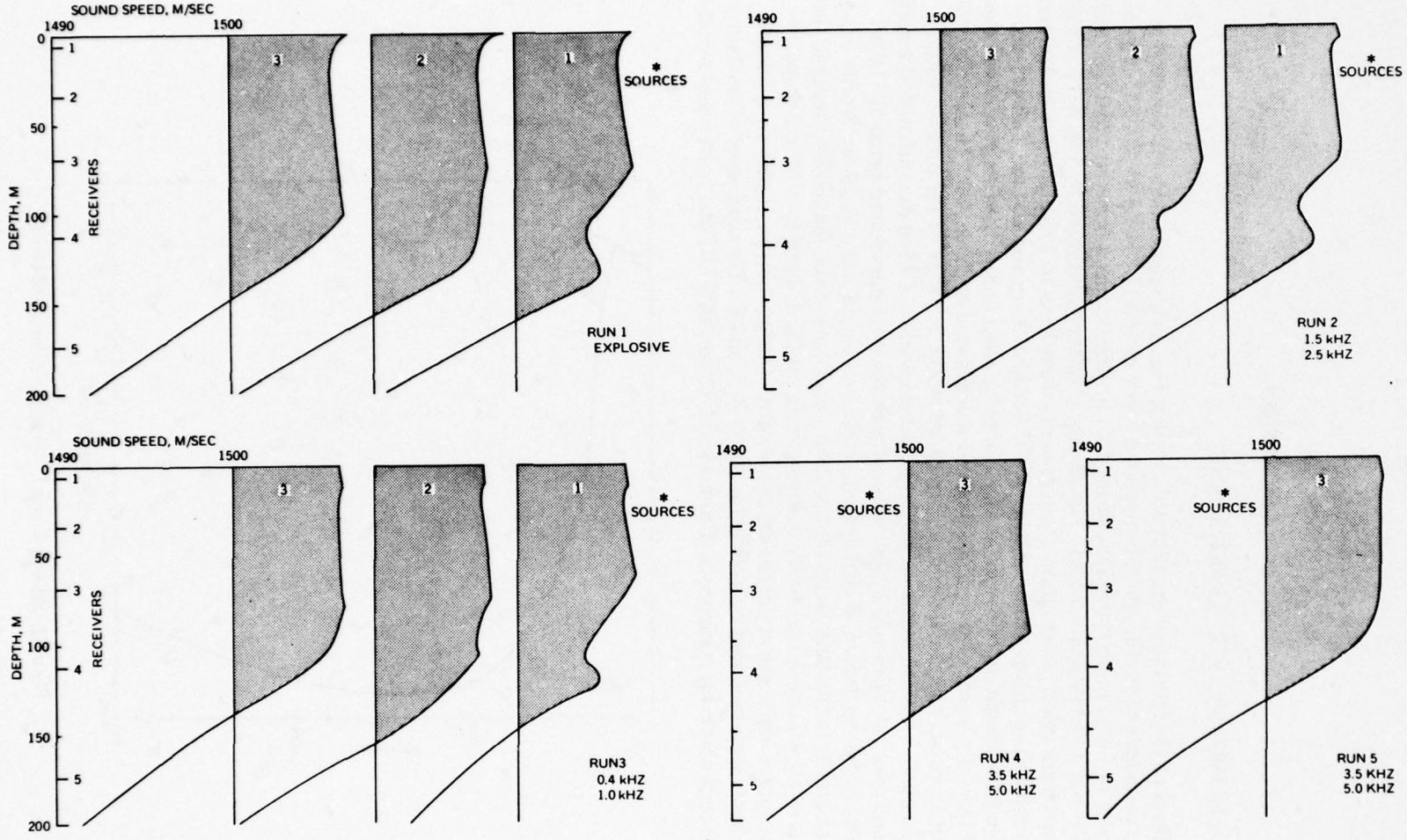


Figure 3. Average sound-speed profile summary for acoustic station 3.

the Teletherm buoy line at a range of 1.0 to 1.5 nm. The measurements made by buoys 2, 5, and 6 are plotted in Fig A-7. Of interest is the near-surface temperature stability present at these three locations. The standard deviation of the average temperature, from the surface to 97.5 m, was less than 0.09°C for sample lengths of 1232, 1246, and 1238 observations made over a period of 3.5 hr. As shown in Fig. A-1 the acoustic propagation paths were in the same plane as the track of the source ship only during the first hour of the run.

During this run, both the *Lee* and *DeSteiguer* reported winds of less than 5 knots, ripples, and 3- to 6-ft swell. Waverider buoy measurements were obtained from 1615 LST to 2130 LST, with no measurements recorded from 1500 LST to 1615 LST. Table A-5 and Figs. A-8 and A-9 present the standard deviation of the Waverider measurements for 3-min averages. Also shown in Figs. A-8 and A-9 is the standard deviation for the complete 5 1/4-hr record. The standard deviation of the 3-min averages varied from 26 to 66 cm, with 87 percent between 30 and 55 cm. To detect any change in sea-surface roughness during the experiment, the original record was divided into five 63-min records and a spectrum analysis was made on each of these subsets. In preparing these spectra, a bandwidth of 0.0056 Hz (21 harmonies) was used. For 42 degrees of freedom the 90-percent confidence limits are 0.68 and 1.36. The 63-min spectra did not indicate any significant change with time. Consequently, they were combined into a single spectrum. Table A-6 contains the ensemble average of the five 63-min spectra. These data are plotted in Fig. A-10. This analysis shows 12- to 15-sec swell present during the run. These wave periods are associated with the 3- to 6-ft swell reported by the *Lee* and *DeSteiguer*.

RUN 2 – 20 February 1972 0105-0603 LST

The individual sound-speed profiles plotted in Fig. B-3 suggest that the source ship recrossed the same sound-speed profile transition volume during run 1 between 0600 LST and 0630 LST. Figure B-11, a plot of 5-min-interval profiles, shows the crossing occurred between 0605 LST and 0620 LST over a distance of about 1.4 kyd. The change is further confirmed by Fig. B-12, a plot of the thermistor chain temperature measurements from 79 m to 130 m. These measurements show a temperature change of from 0.5 to 1.0°C between 85 and 107 m. This decrease in temperature resulted in the formation of a depressed channel.

Figure 4 is a plot of the profile 3 sound speeds listed in Table B-3. The details of the three profiles present during run 2 are shown in Fig. 3. As a result of nighttime cooling of the surface waters, all profiles show a 6-m surface channel. Profile 1 contains two depressed channels – a 50-m channel with the minimum sound speed at 20 m and a 20-m channel with the minimum sound speed at 101 m. Profile 3 has a 54-m depressed channel with the minimum sound speed at 20 m. Profile 2 is not an average profile in the same sense that profile 1 and 3 are, since the profile shapes in the transition water volume are gradually changing from profile 3 shape to profile 1 shape. During this run usable temperature measurements were recorded by Teletherm buoys 2, 3, 5, and 6. The remainder of the buoys did not record usable measurements. From the beginning of the run to 0240 LST, the source ship paralleled the Teletherm buoy line at a range of about 2.3 nm at 0100 LST to about 1.0 nm at 0240 LST. The measurements made by buoys 2, 3, 5, and 6 are plotted in Fig. B-7. As indicated by the random scatter of the temperature measurements, buoy 5 appears to be the most accurate. Of interest is the temperature stability from the surface to 97.5 m as measured by the eight sensors on buoy 5. Each sensor made 1931 temperature measurements over a period of 6 hr while drifting 4.2 nm. The standard deviation for each sensor varied from a minimum of 0.01°C at 83.8 m to a maximum of 0.04°C to 70.1 m. As shown in Fig. B-1

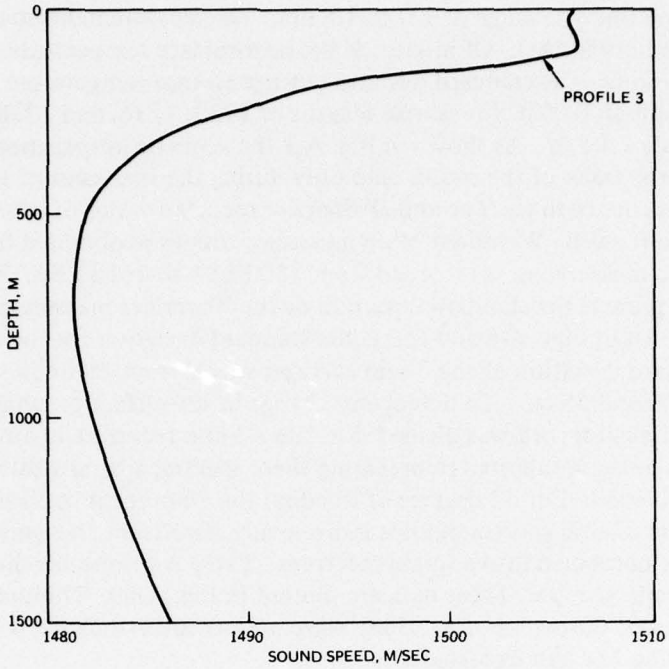


Figure 4. Station 3, run 2. Average sound-speed profile.

the propagation paths closely coincided with the track of the source ship and the plane of the source ship's measurement.

During the run, both the *Lee* and *DeSteiguer* reported winds less than 5 knots at the beginning of the run, increasing to about 10 knots at 0400 LST, waves less than 1 ft, and 3- to 4-ft swell. Measurements were obtained by the Waverider buoy for all but the first 5 min of the run. Table B-5 and Figs. B-8 and B-9 present the standard deviation of the Waverider buoy measurements for 3-min averages. Also shown on Figs. B-8 and B-9 is the standard deviation for the complete 5-hr 10-min record. The standard deviation of the 3-min averages varied from 26 to 58 cm, with 77.8 percent between 30 and 50 cm. To detect any change in sea-surface roughness during the experiment, the original record was divided into five 63-min records, and a spectrum analysis was made of each of these subsets. In preparing these spectra, a bandwidth of 0.0056 Hz (21 harmonics) was used. For 42 degrees of freedom the 90 percent confidence limits are 0.68 to 1.36. The 63-min spectra did not indicate any significant change with time. Table B-6 lists the ensemble average of the five 63-min spectra. These data are plotted in Fig. B-10. This analysis shows the presence of 12- to 15-sec swell. These wave periods are associated with the 3- to 6-ft swell reported by the *Lee* and *DeSteiguer*.

RUN 3 – 20 February 1972 0658-1418 LST

The individual sound-speed profiles plotted in Fig. C-3 suggest that between 0657 and 0800 LST, the source ship recrossed the same sound-speed profile transition volume crossed during runs 1 and 2. Figure C-11, a plot of 5-min-interval profiles, shows the crossing occurred between 0705 LST and 0730 LST over a distance of about 2.3 kyd. The change is further confirmed by Fig. C-12, a plot of the thermistor chain measurements from 79 m to

130 m. These measurements show a temperature change of 0.5°C to 1.0°C between 85 m and 107 m. This increase in temperature resulted in the elimination of a depressed channel present at the start of the run.

Figure 5 is a plot of the profile 3 sound speeds listed in Table C-3. The details of the three profiles are shown in Fig. 3. Profile 1 contains an 11-m surface channel and two depressed channels – a 20-m channel with the minimum sound speed at 20 m and a 22-m channel with the minimum sound speed at 105 m. Profile 3 contains an 11-m surface channel and a small depressed channel centered at 20 m. A sound-speed maximum is observed at 79 m. Again, profile 2 is not an average profile in the same sense that profiles 1 and 3 are. Profile 2 is characterized by an 11-m surface channel and minor depressed channels. During this run usable temperature measurements were recorded by Teletherm buoys 5 and 6. The remainder of the buoys did not record any usable measurements. From 1130 LST to 1300 LST the source ship paralleled the Teletherm buoy line at a range of about 0.5 nm at 1130 LST to about 2.0 nm at 1300 LST. The measurements for buoys 5 and 6 are plotted in Fig. C-7. As indicated by the random scatter of the temperature measurements, buoy 5 appears to be the most accurate. Of interest is the temperature stability from the surface to 97.5 m as measured by the eight sensors on buoy 5. Each sensor made 2442 measurements over a period of 7 hr 20 min while drifting 3.4 nm. The standard deviation for each sensor varied from a minimum of 0.03°C at 97.5 m to a maximum of 0.10°C at 42.7 m. As shown in Fig. 1C the propagation paths were almost in the plane of the source ship's track.

During the run the *Lee* reported 10- to 12-knot winds, 2-ft waves, and 3-ft swell. The *DeSteiguer* reported 8- to 10-knot winds, 1-ft waves, and 3- to 5-ft swell. No Waverider buoy measurements were obtained during run 3.

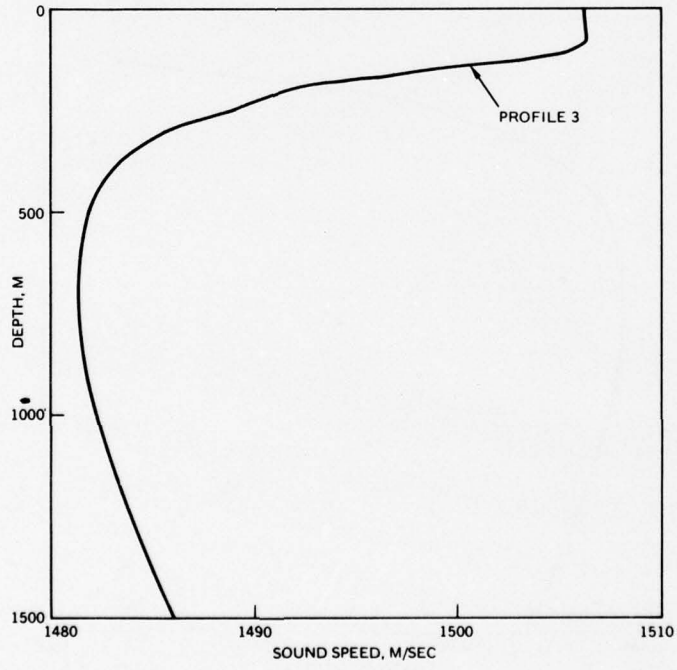


Figure 5. Station 3, run 3. Average sound-speed profile.

RUN 4 – 20 February 1972 1531-2052 LST

As shown in Fig. D-1 the source ship made a 45-deg course change between 1640 LST and 1710 LST. This course change was made in an attempt to parallel the Teletherm buoy line at a range of about 1 nm from 1531 LST to about 1710 LST. However, it also resulted in propagation paths that do not parallel the course of the source ship. An examination of the plots of the individual sound-speed profiles plotted in Fig. D-3 shows intermittent surface channels to depths of 50 m and small depressed channels, sometimes multiple, from 10 m to 75 m.

Figure 6 is a plot of the average sound-speed profile listed in Table D-3. The average profile is characterized by a 10-m surface channel and a 65-m depressed channel, with the minimum sound speed at 30 m. During this run usable temperature measurements were recorded on Teletherm buoys 5 and 6. The remainder of the buoys did not record usable measurements. The measurements made by buoys 5 and 6 are plotted in Fig. D-7. As indicated by the random scatter of the temperature measurements, buoy 5 again appears to be the most accurate. The temperature stability, previously noted, is again confirmed. Each sensor in the surface to 97.5-m layer made 1702 temperature measurements over a period of 5 hr 21 min. The standard deviations for these sensors varied from a minimum of 0.03°C to a maximum of 0.07°C.

During run 4 the *Lee* reported 7- to 10-knot winds, 1- to 2-ft waves, and 3-ft swell. The *DeSteiguer* reported 7- to 11-knot winds, 1-ft waves, and 3- to 5-ft swell. Waverider buoy measurements for the complete run, except for a 2-min break in the record from 1801 LST to 1803 LST, were obtained. Table D-5 and Figs D-8 and D-9 present the standard deviations of the measurements for 3-min averages, with the standard deviation for the complete

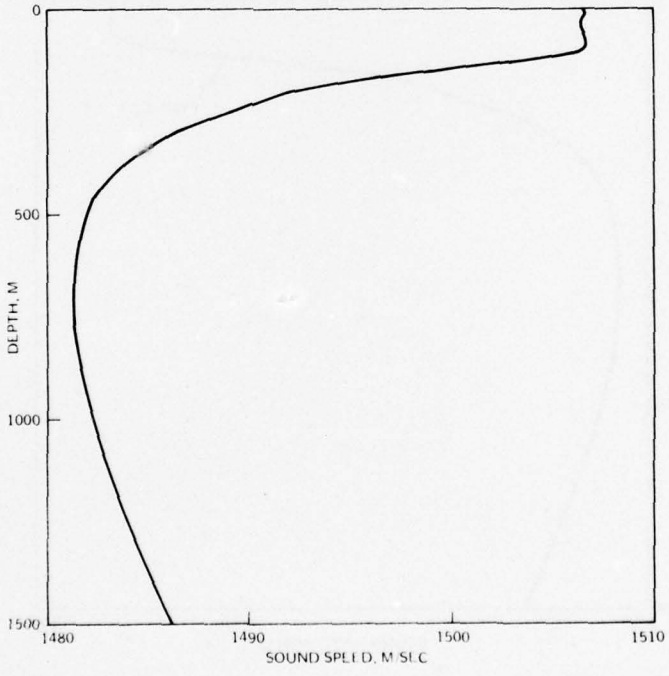


Figure 6. Station 3, run 4. Average sound-speed profile.

5-hr 21-min record also shown. The standard deviation of the 3-min averages varied from 35 to 80 cm, with 64.7 percent between 35 and 60 cm. Because of the 2-min break in the Waverider buoy record, it is necessary in applying spectral analysis techniques to consider the record as consisting of two segments – 1531 to 1800 LST and 1804 to 2052 LST. To detect any change in sea-surface roughness during the experiment, the first segment was divided into three 50-min records and the second segment into three 56-min records. A spectrum analysis was made on each of these subsets. In preparting these spectra, a bandwidth of 0.0057 Hz (17 harmonics for the first segment and 19 harmonics for the second segment) was used. For these two segments the 90-percent confidence limits are 0.65 to 1.40 (34 degrees of freedom) and 0.67 to 1.39 (38 degrees of freedom), respectively. The individual spectra did not indicate any significant change with time. Consequently, they were combined into two spectra characteristic of each of the record segments. Table D-6 contains a tabulation of the ensemble average of the individual spectra. These data are plotted in Fig. D-10. During run 2, a 12- to 15-sec swell was present. These wave periods are associated with the 3- to 5-ft swell reported by the *Lee* and *DeSteiguer*. Also present were 1.5- to 4.5-sec wind waves associated with the local seas generated by the 7- to 11-knot wind reported by the *Lee* and *DeSteiguer*.

RUN 5 – 20-21 February 1972 2131-0400 LST

As shown in Fig. D-1 the source ship made several course changes between 2315 and 0040 LST. As a result, the propagation paths do not parallel the track of the source ship after 2330 LST. An examination of the individual sound-speed profiles plotted in Fig. E-3 show surface channels varying in depth from 6 to 50 m and a few depressed channels from 20 to 85 m.

Figure 7 is a plot of the average sound speeds listed in Table E-3. The details of the average sound-speed distribution in the upper 200 m are shown in Fig. 3. The average sound-speed profile is charactered by a 10-m surface channel and a minor depressed channel, with the minimum sound speed at 20 m. During this run usable temperature measurements were obtained by buoys 5 and 6. The remainder of the buoys did not give any usable measurements. The measurements for Teletherm buoys 5 and 6 are plotted in Fig. E-7. As indicated by the random scatter of the temperature measurements, buoy 5 again appears to be the most accurate. Again, the previously observed temperature stability in the near-surface layers is confirmed.

During the run the *Lee* reported 6-knot winds, 1-ft waves, and 3-ft swell. The *DeSteiguer* reported light airs to 6-knot winds, 1-ft waves, and 3-ft swell. Waverider buoy measurements were obtained from 0000 to 0300 LST on 21 February 1972. No measurements were obtained at the beginning or end of the run. Table E-5 and Figs. E-8 and E-9 present the standard deviation of the Waverider buoy measurements for 3-min averages. The standard deviation of the 3-min averages varied from 32 to 74 cm, with 66.7 percent between 40 and 60 cm. To detect any change in sea-surface roughness, the Waverider record was divided into three 60-min records. A spectrum analysis was made of each of these subsets. In preparing the spectra a bandwidth of 0.0053 Hz (19 harmonics) was used. The 90-percent confidence limits are 0.67 to 1.39 (38 degrees of freedom). The individual spectra did not indicate any significant change with time. Consequently, they were combined into a single spectrum. Table E-6 contains a tabulation of the ensemble average of the individual spectra. These data are plotted in Fig. E-10. This analysis shows that 11.5- to 14.0-sec swell were present during run 5. These wave periods are associated with the 3-ft swell reported by the *Lee* and *DeSteiguer*. Additionally, 3.5-sec wind waves, associated with the local seas generated by the 6 to 10-knot wind, were present.

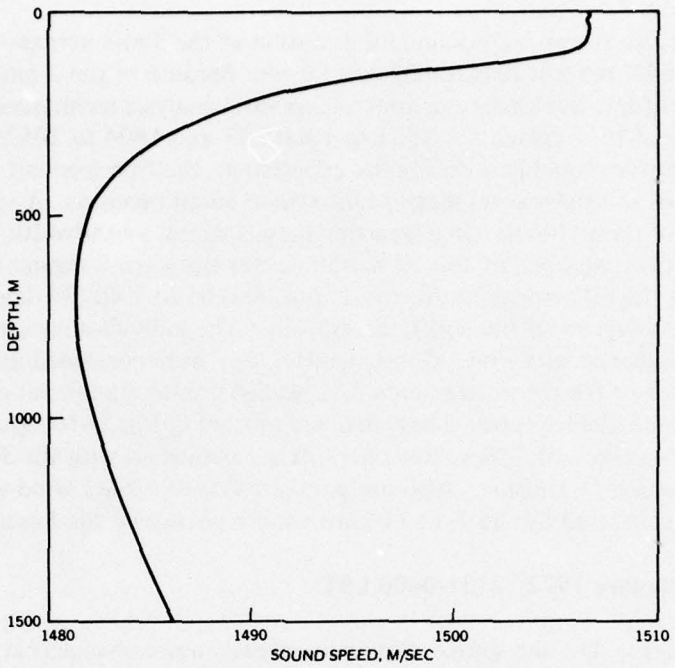


Figure 7. Station 3, run 5. Average sound-speed profile.

SUMMARY

Five propagation loss runs, including four CW runs and one explosive run, were made over a 37-hr period from 19 February 1500 LST to 21 February 0400 LST. Oceanographic measurements made in this area during these experiments showed the experimental area contained two water masses, each characterized by a unique sound-speed profile. These water masses were separated by a transitional water mass.

At the start of runs 1 and 3, the receivers were in a water volume designated as profile 3 and the sources were in a water volume designated as profile 1. As the runs progressed, the sources were towed through a profile 2 water volume into the profile 3 water volume, while the receivers remained in the profile 3 water volume. During run 2, both sources and receivers were in the profile 3 volume at the start of the run. As the run progressed, the sources were towed through the profile 2 volume and into the profile 1 volume, while the receivers remained in the profile 3 volume. During runs 1, 2, and 3, most of the propagation loss measurements were made in the profile 3 volume. Runs 4 and 5 were both conducted in the profile 3 volume. During runs 1, 2, and 4 the profile 3 volume was characterized by a well-developed depressed channel. During runs 2 and 4, profile 3 also exhibited a 6-m surface sound channel. During run 3, profile 3 contained a well-developed 80-m surface sound channel and run 5 a 6-m surface sound channel underlain by a weak negative sound-speed gradient to a depth of about 80 m. During runs 1, 2, and 3, the profile 1 volume was characterized by two well-developed depressed channels, with a 6- to 11-m surface channel developing during runs 2 and 3.

Mild weather prevailed during the time the acoustic runs were made. Wind speeds varying from near calm to 11 knots produced 1- to 2-ft waves, which were accompanied by 3- to 6-ft swell. Spectral analysis of the sea-surface roughness measurements made by the Waverider buoy during runs 1, 2, 4, and 5 showed 12- to 15-sec swell accompanied by 1.5- to 4.5-sec wind waves during runs 4 and 5. For all runs there was no detectable change in the spectra during the runs.

APPENDIX A

STATION 3 RUN 1

DETAILED ENVIRONMENTAL DATA SUMMARY

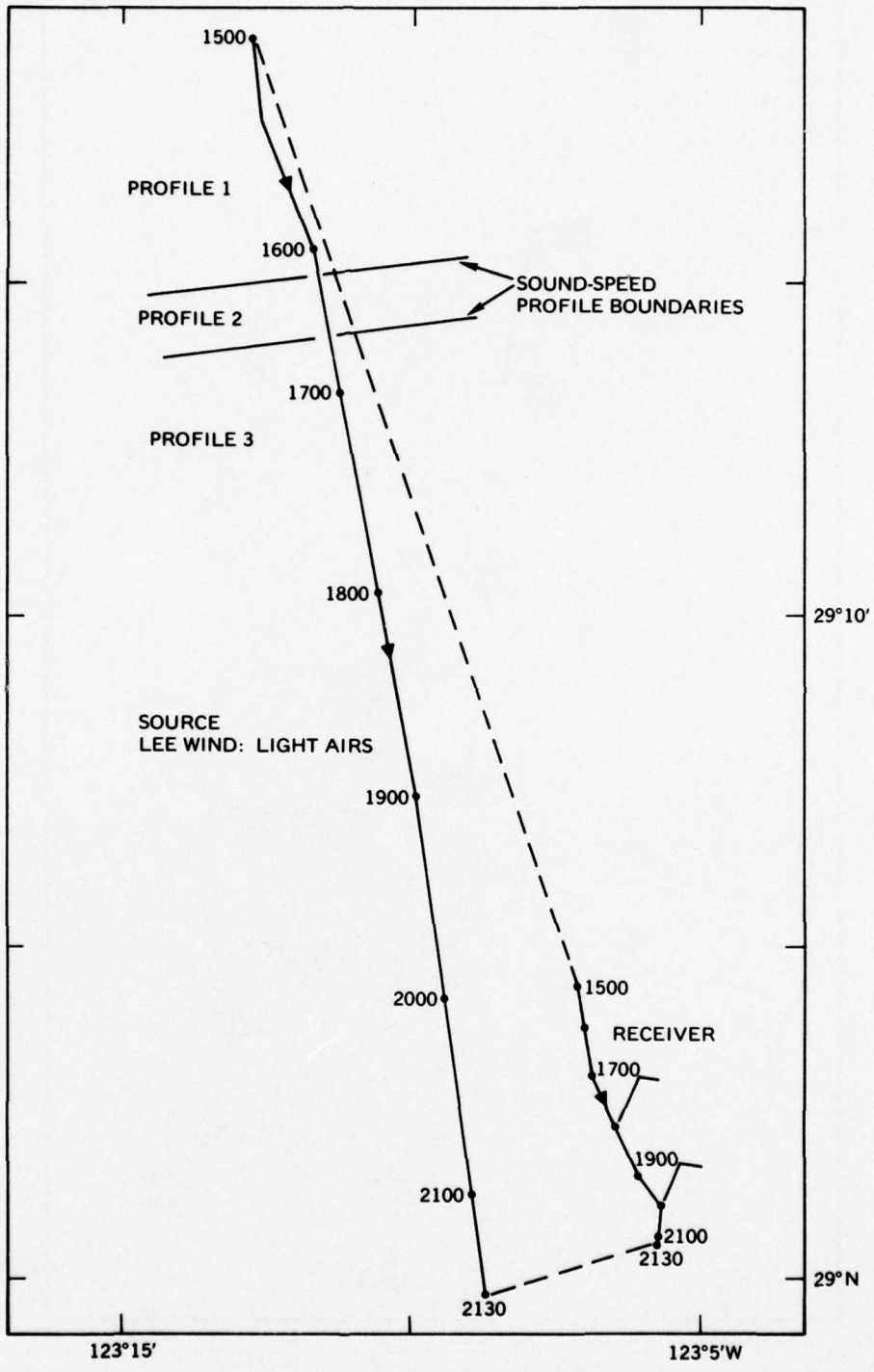


Figure A-1. Station 3, run 1. Location of source and receiver ships, 1500 and 2130 LST propagation paths (---), and wind velocity (•—\ 5-knot east wind).

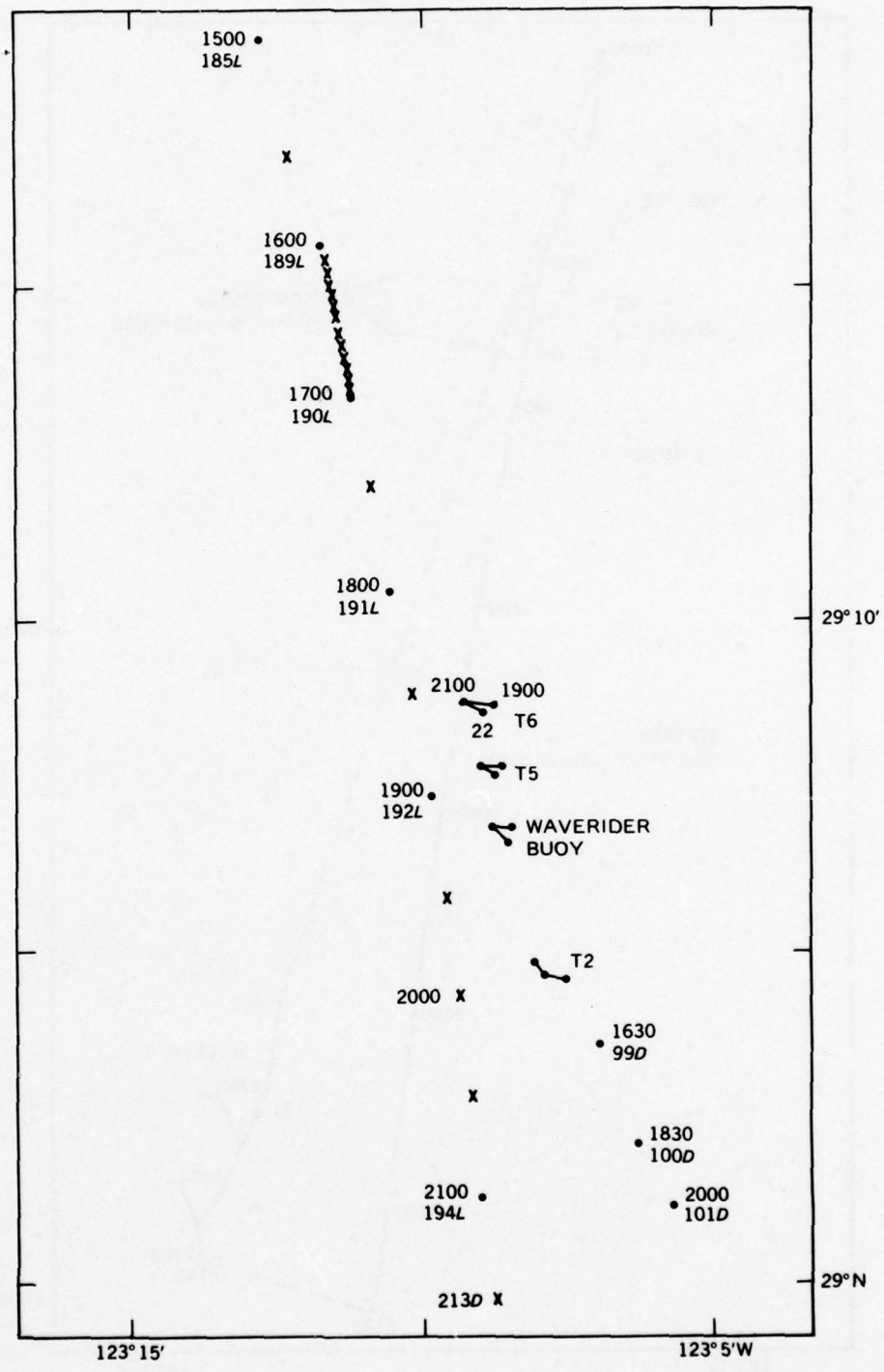


Figure A-2. Station 3, run 1. Location of XBT (·), thermistor chain (X), Teletherm buoy (T), and Waverider buoy measurements. The letter following the XBT number denotes the ship which took the measurement (*L: Lee, D: DeSteiguer*). Times shown are LST.

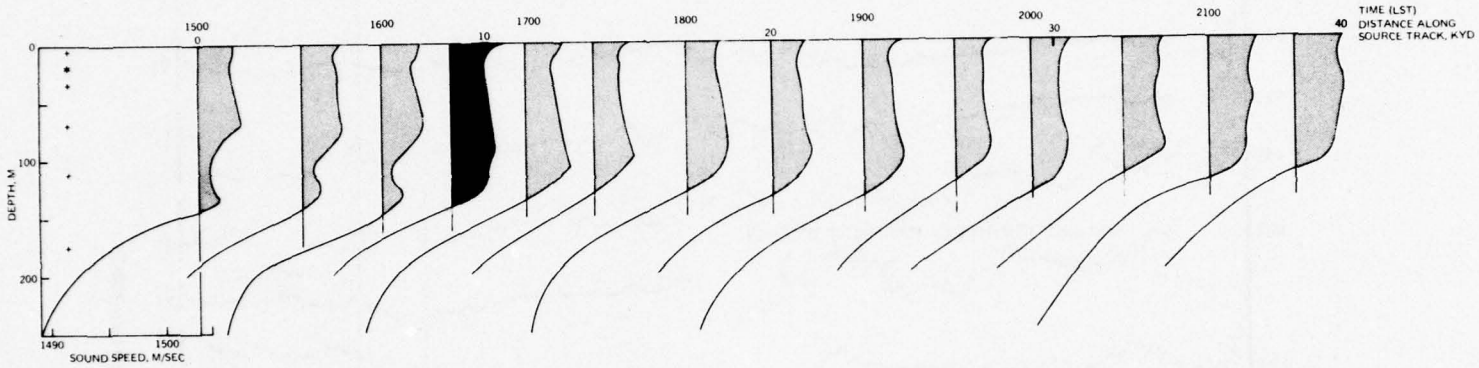


Figure A-3. Station 3, run 1. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depth (+).

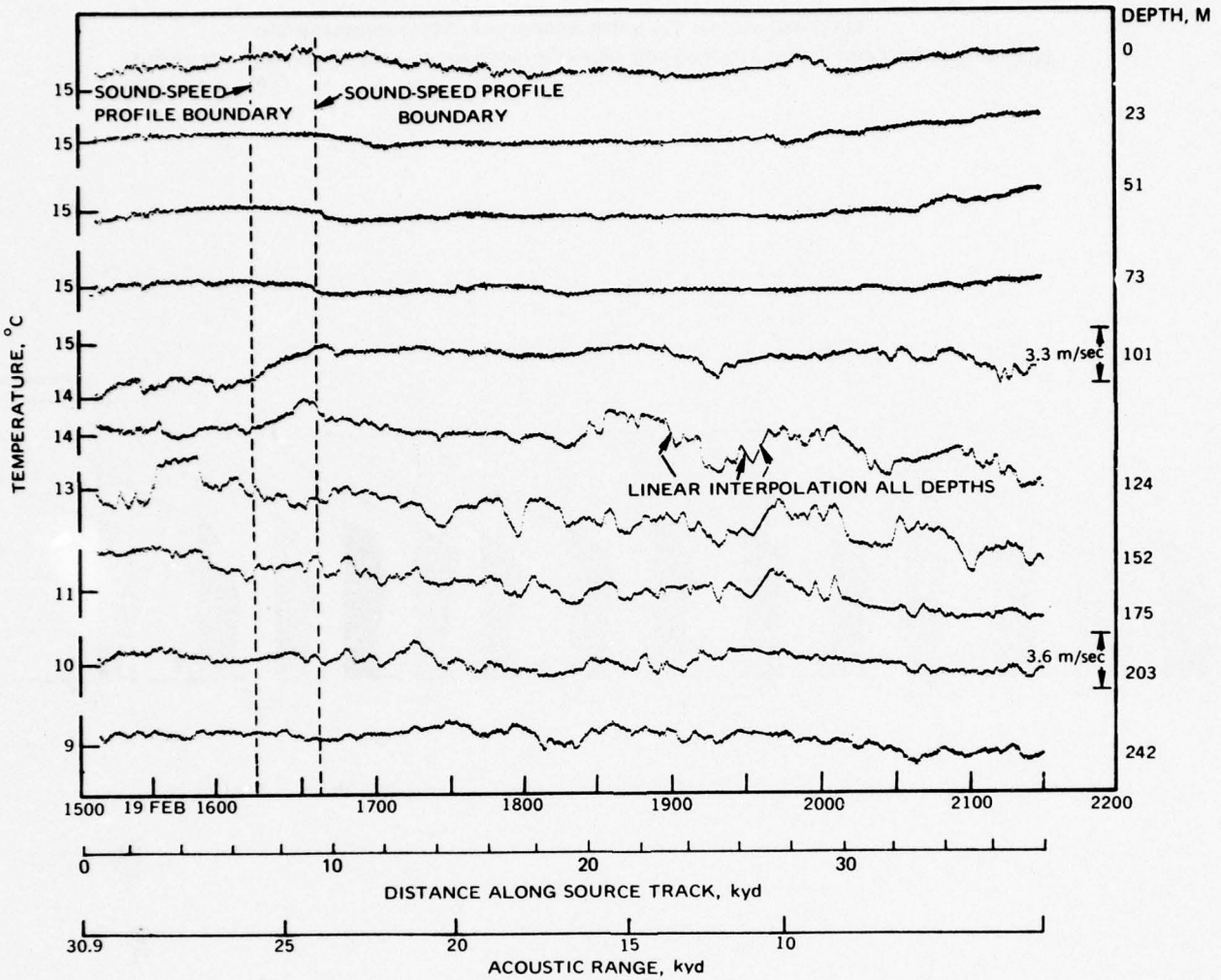


Figure A-4. Station 3, run 1. Thermistor chain temperature measurements at selected depths. Dotted lines indicate transition between two sound-speed profile shapes. Time is LST.

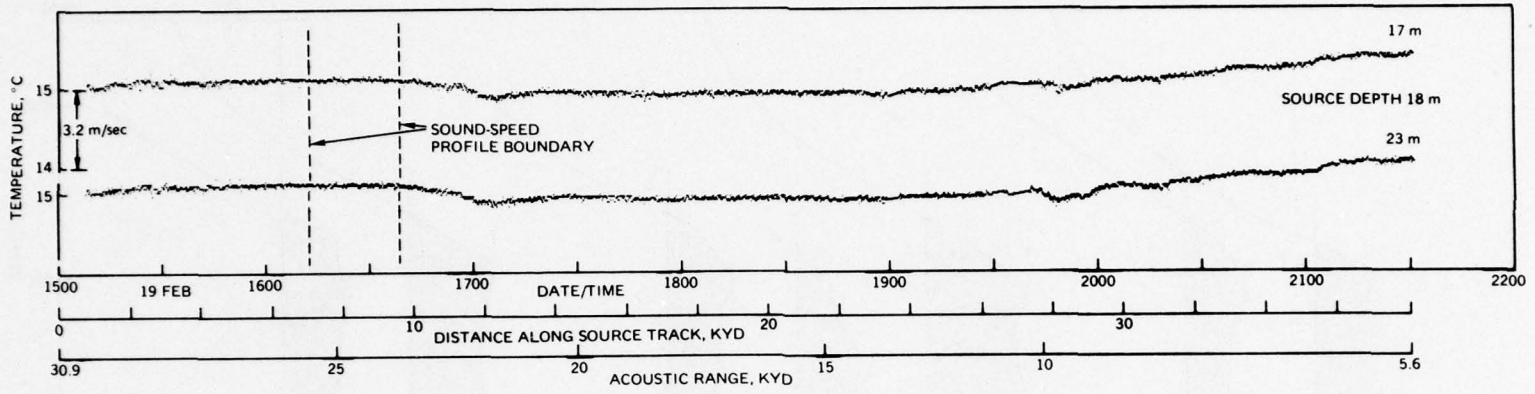


Figure A-5. Station 3, run 1. Temperatures above and below source. Time is LST.

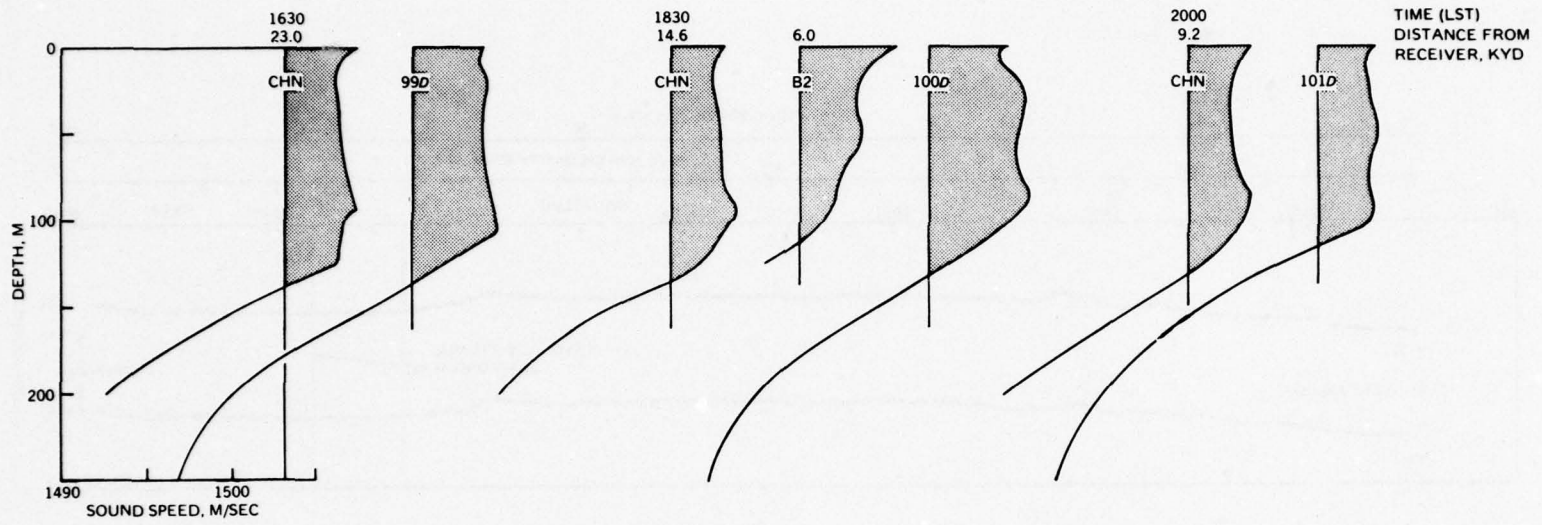


Figure A-6. Station 3, run 1. Spatial change in sound-speed profiles.

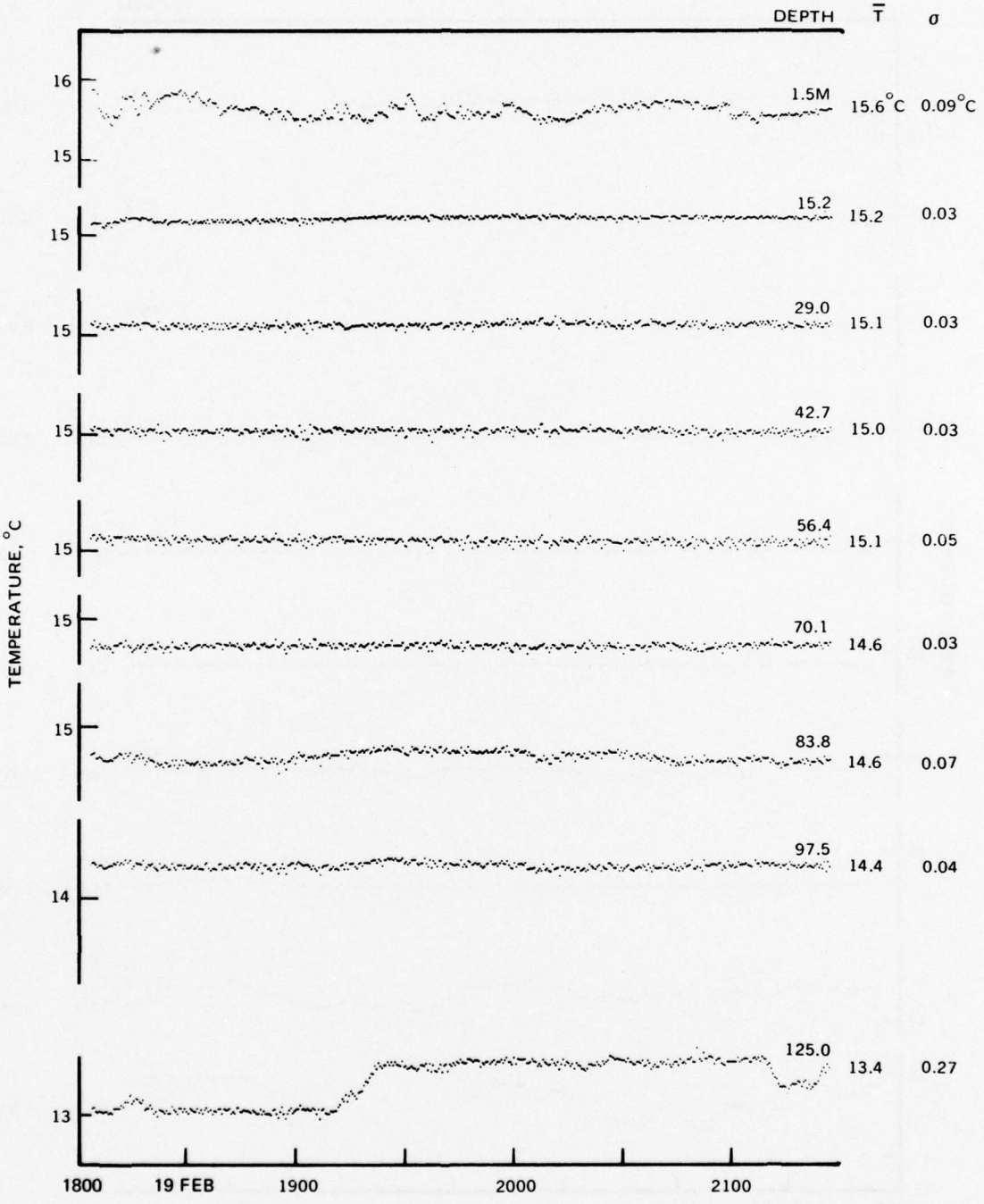


Figure A-7a. Station 3, run 1. Teletherm buoy 2 temperature measurements (n = 1232). Time is LST.

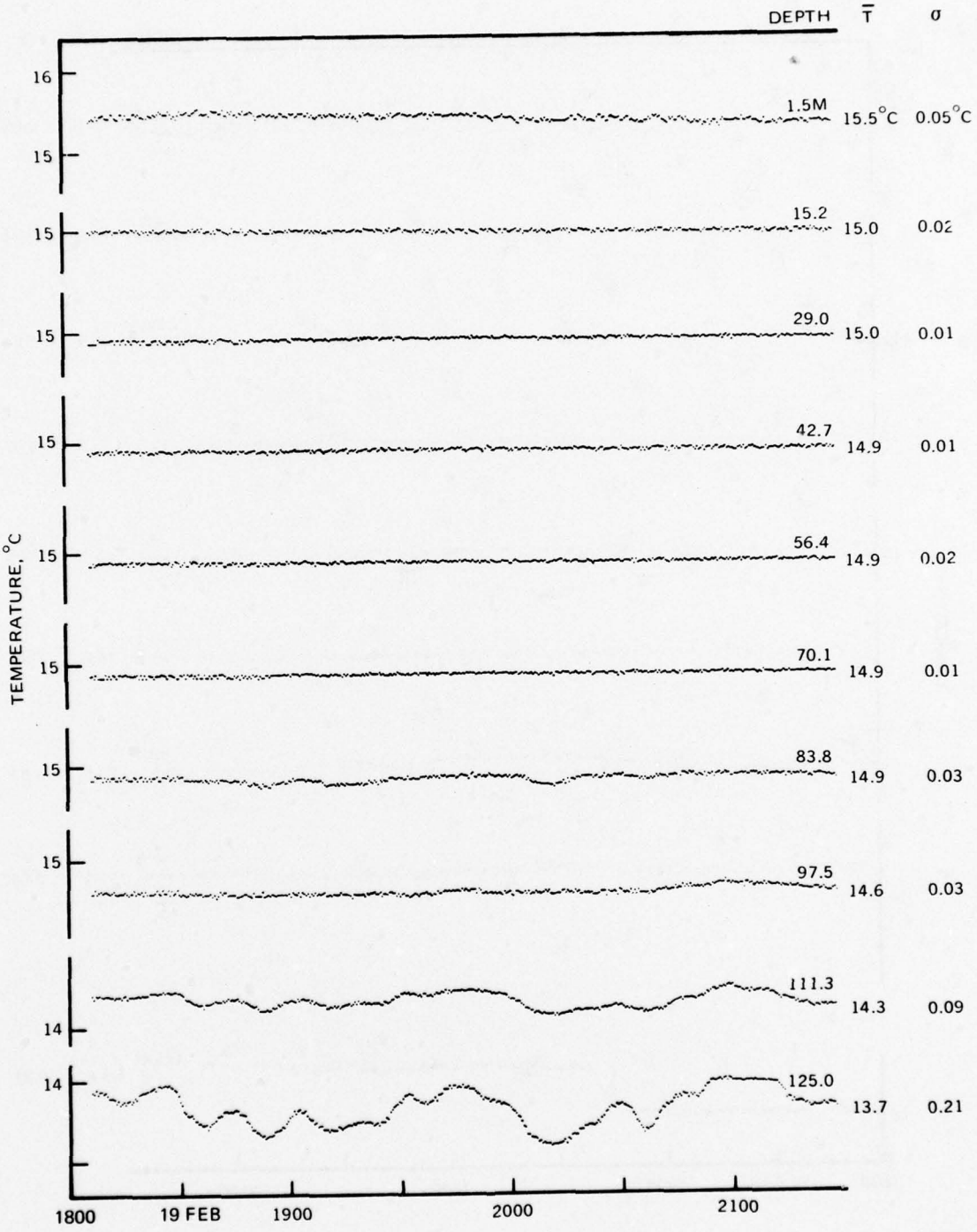


Figure A-7b. Station 3, run 1. Teletherm buoy 5 temperature measurements (n = 1246). Time is LST.

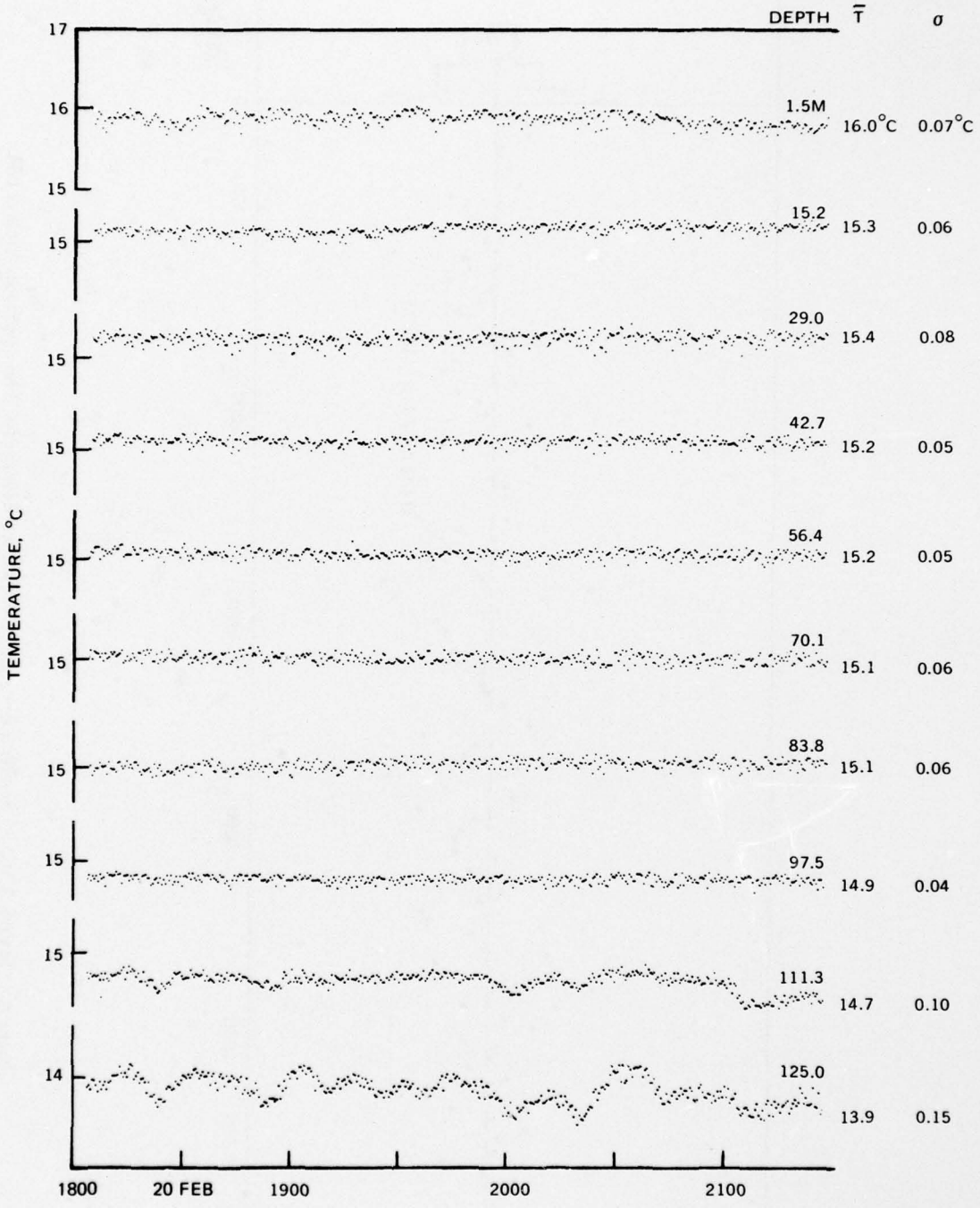


Figure A-7c. Station 3, run 1. Teletherm buoy 6 temperature measurements (n = 1229). Time is LST.

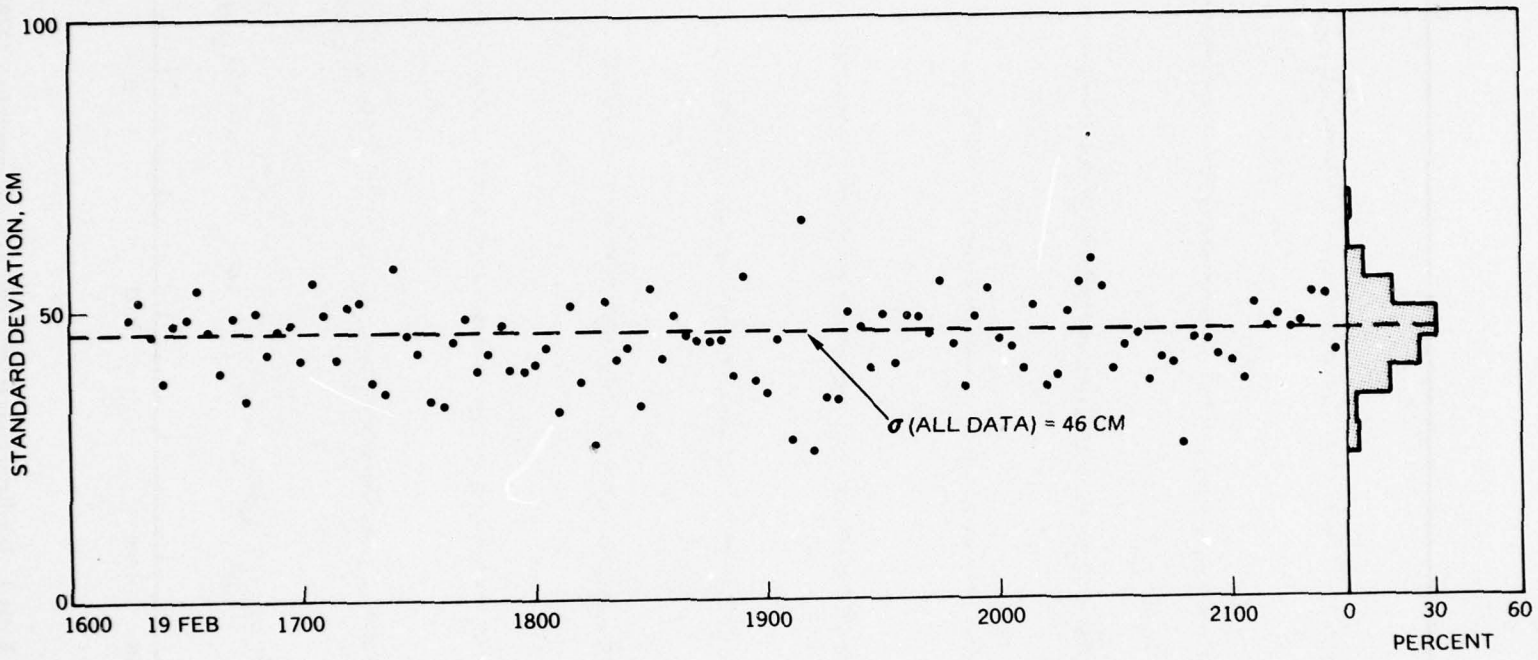


Figure A-8. Station 3, run 1. Standard deviation of surface-wave height for 3-min averages. Time is LST.

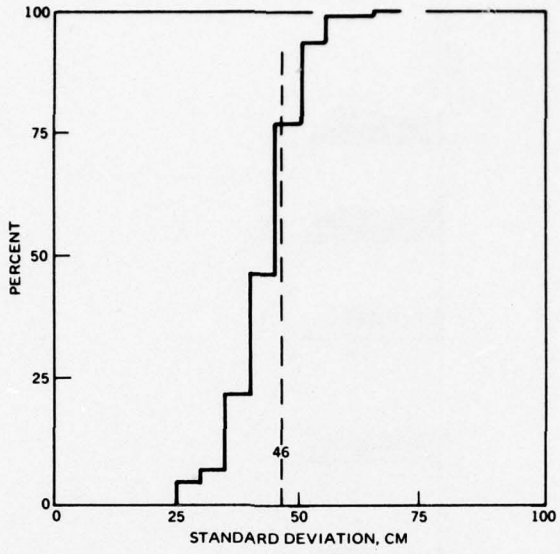


Figure A-9. Station 3, run 1. Ogive of standard deviation of surface-wave height for 3-min averages.

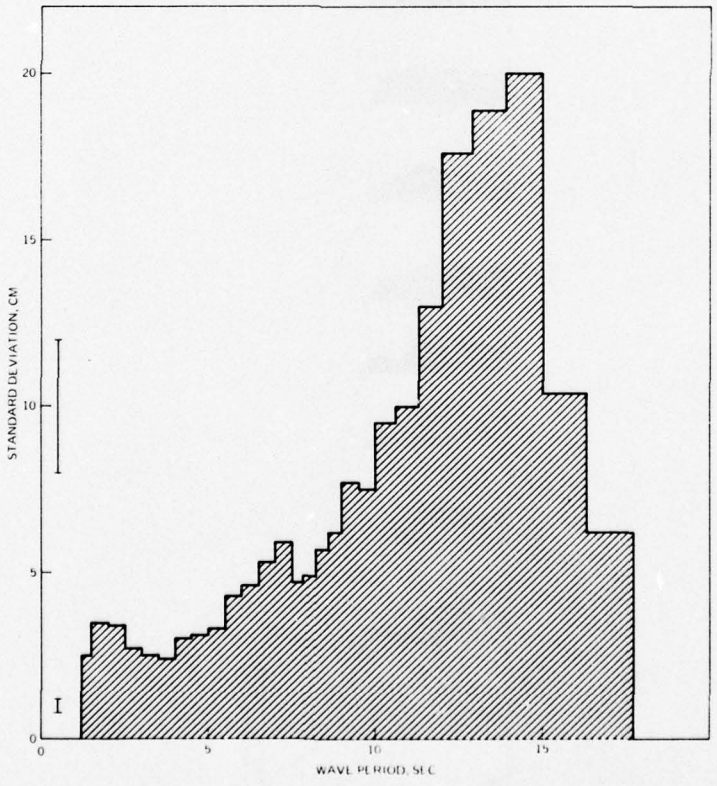


Figure A-10. Station 3, run 1. Standard deviation of wave height as a function of wave period (19 February 1972, 1615-2130 LST).

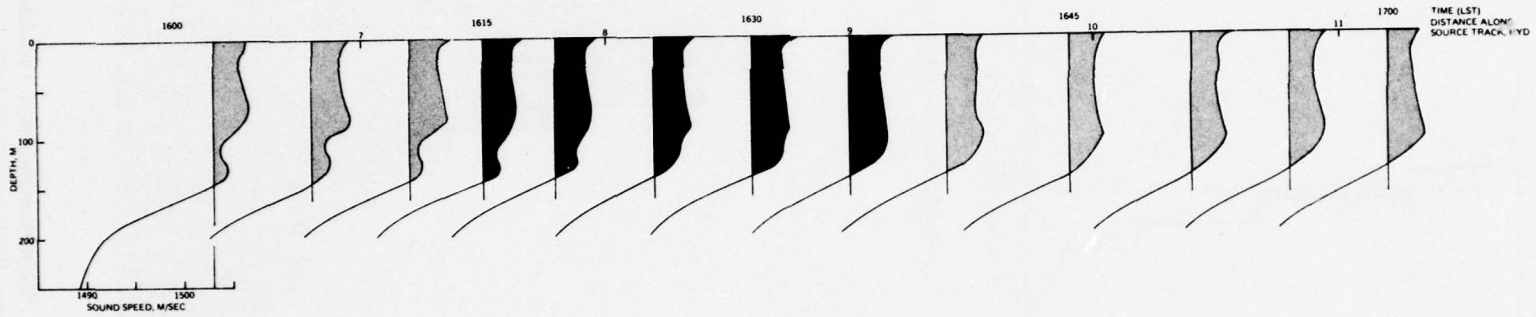


Figure A-11. Station 3, run 1. Expanded sound-speed profile plot.

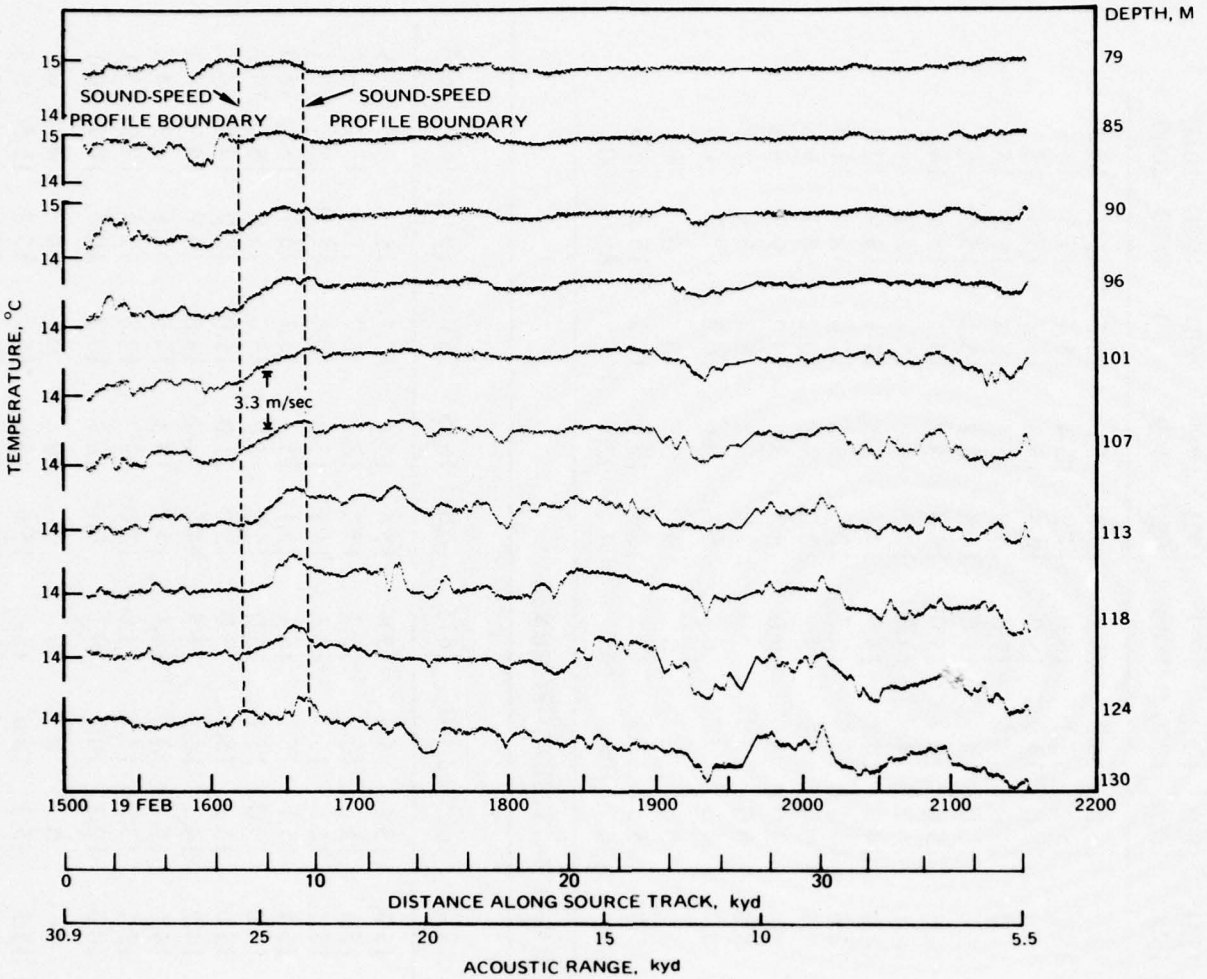


Figure A-12. Station 3, run 1. Thermistor chain temperature measurements at about 6-m depth intervals from 79 to 130 m. Dotted lines indicate transition between two sound-speed profile shapes. Time is LST.

Table A-1. Temperature Profiles (°C),
Station 3 Run 1 (19 February 1972 1500-2130 LST).

XBT MEASUREMENTS

Depth, m	185L 1500	189L 1600	190L 1700	191L 1800	192L 1900	194L 2100	99D 1630	100D 1830	101D 2000
0	15.2	15.3	15.3	15.2	15.3	15.6	15.5	15.7	15.3
10	15.1	15.2	15.1	15.0	14.9	15.4	15.4	15.5	15.1
20	15.0	15.0	14.9	15.0	14.9	15.3	15.5	15.8	15.1
30	15.0	15.0	14.9	15.0	14.9	15.2	15.4	15.8	15.1
50	15.0	15.0	14.9	15.0	14.8	15.2	15.3	15.6	15.1
75	14.8	15.0	14.9	15.0	14.8	14.9	15.2	15.5	14.8
100	14.1	14.2	14.9	14.8	14.8	14.7	15.2	15.2	14.7
125	14.0	14.0	14.1	13.9	14.1	13.3	14.1	13.9	12.9
150	12.8	13.3	12.8	12.3	12.5	11.5	12.8	12.6	11.6
200	10.1	10.0	10.0	9.9	10.0	9.8	10.2	10.3	9.6
250	8.9	9.0	8.9	9.0	8.8	8.6	9.0	9.2	8.6
300	8.0	8.0	7.8	7.9	7.9	7.8	8.3	8.3	7.8
400	6.7	6.5	6.7	6.8	6.8	6.6	6.9	7.0	6.5
ILD	0	0	0	0	0	0	0	0	0
T	15.2	15.3	15.3	15.2	15.3	15.6	15.5	15.7	15.3
SLD	130	130	108	105	100	92	105	85	100

THERMISTOR CHAIN MEASUREMENTS

Depth, m	1530	1605	1610	1615	1620	1625	1630	1635	1640	1645
0	15.3	15.5	15.6	15.6	15.6	15.6	15.7	15.7	15.5	15.5
10	15.1	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
20	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
30	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.0
50	15.0	15.0	15.1	15.0	15.0	15.0	15.0	15.0	15.0	14.9
75	15.0	15.1	15.1	15.0	15.0	15.0	15.0	15.0	14.8	14.8
100	14.2	14.3	14.3	14.5	14.6	14.7	14.8	14.9	14.9	14.8
125	14.1	14.2	14.0	14.1	14.2	14.3	14.5	14.5	14.3	14.2
150	13.1	13.3	13.1	13.0	13.0	13.0	12.8	12.9	12.9	13.1
200	10.3	10.2	10.1	10.1	10.1	10.3	10.2	10.3	10.1	10.1
ILD	0	0	0	0	0	0	0	0	0	0
T	15.3	15.5	15.6	15.6	15.6	15.6	15.7	15.7	15.5	15.5
SLD	125	125	135	135	125	90	96	107	100	100

Table A-1, continued.

Depth, m	1650	1655	1730	1830	1930	2000	2030	2130
0	15.6	15.6	15.3	15.2	15.3	15.4	15.3	15.6
10	15.1	15.1	14.9	15.0	15.0	15.1	15.2	15.4
20	15.0	15.0	14.9	14.9	15.0	15.0	15.2	15.4
30	15.0	14.9	14.8	14.9	14.9	14.9	15.1	15.4
50	14.8	14.8	14.8	14.9	14.8	14.8	14.9	15.3
75	14.8	14.9	14.8	14.8	14.8	14.8	14.9	15.0
100	14.8	14.8	14.8	14.8	14.6	14.7	14.7	14.7
125	14.2	14.1	13.9	14.1	13.5	13.9	13.2	13.0
150	13.1	13.0	12.5	12.5	12.2	12.6	12.1	11.8
200	10.3	10.1	10.1	10.3	10.2	10.1	10.0	9.9
ILD	0	0	0	0	0	0	0	0
T	15.6	15.6	15.3	15.2	15.3	15.4	15.3	15.6
SLD	107	107	100	96	90	85	95	100

TELETHERM BUOY MEASUREMENTS

Depth, m	1830
0	16.0
10	15.4
20	15.2
30	15.1
50	15.1
75	14.6
100	14.2
125	13.0
ILD	0
T	16.0
SLD	–

Table A-2. Computed Sound-Speed Profiles (m/sec), Station 3 Run 1 (19 February 1972 1500-2130 LST).

XBT MEASUREMENTS

Depth, m	185L 1500	189L 1600	190L 1700	191L 1800	192L 1900	194L 2100
0	1506.0	1506.3	1506.3	1506.0	1506.3	1507.2
10	05.8	06.1	05.8	05.5	05.2	06.8
20	05.6	05.6	05.3	05.6	05.3	06.6
30	05.8	05.8	05.5	05.8	05.5	06.5
50	06.2	06.2	05.8	06.2	05.5	06.8
75	05.9	06.6	06.2	06.6	05.9	06.2
100	04.1	04.4	06.8	06.5	06.5	06.1
125	04.3	04.3	04.7	04.0	04.7	01.9
150	00.7	02.5	00.7	1499.0	1499.7	1496.2
200	1492.3	1491.9	1491.9	91.6	91.9	91.2
250	89.0	89.4	89.0	89.4	88.6	87.8
300	86.5	86.5	85.8	86.2	86.2	85.9
400	83.3	82.4	83.3	83.7	83.7	82.9
SC	0	0	0	0	0	0
DC	20	20	20	10	10	30
MAX	70	75	108	75	100	50
DC	110	110				
MAX	135	133				

Depth, m	99D 1630	100D 1830	101D 2000
0	1506.9	1507.6	1506.3
10	06.8	07.1	05.8
20	07.2	08.2	06.0
30	07.1	08.4	06.1
50	07.1	08.1	06.5
75	07.2	08.2	05.9
100	07.8	07.8	06.1
125	04.7	04.0	00.6
150	00.7	00.0	1496.5
200	1492.6	1493.0	90.5
250	89.4	90.1	87.8
300	87.7	87.7	85.8
400	84.1	84.5	82.4
SC	0	0	0
DC	10	10	10
MAX	20	30	50
DC	40	60	75
MAX	105	85	100

Table A-2, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	1530	1605	1610	1615	1620	1625	1630	1635
0	1506.3	1506.9	1507.2	1507.2	1507.2	1507.2	1507.6	1507.6
10	05.8	06.1	06.1	06.1	06.1	06.1	06.1	06.1
20	06.0	06.0	06.0	06.0	06.0	06.0	06.0	06.0
30	06.1	06.1	06.1	06.1	06.1	06.1	06.1	06.1
50	06.2	06.2	06.5	06.2	06.2	06.2	06.2	06.2
75	06.6	06.9	06.9	06.6	06.6	06.6	06.6	06.6
100	04.4	04.8	04.8	05.5	05.8	06.1	06.5	06.8
125	04.7	05.0	04.3	04.7	05.2	05.4	06.0	06.0
150	01.8	02.5	01.8	01.4	01.4	01.4	00.7	01.0
200	1493.0	1492.6	1492.3	1492.3	1492.3	1493.0	1492.6	1493.0
SC	0	0	0	0	0	0	0	0
DC	10	20	20	20	20	20	20	20
MAX	75	79	79	73	73	90	96	107
DC	110	105	105	115	118			
MAX	125	125	135	135	125			

Depth, m	1640	1645	1650	1655	1730	1830	1930	2000
0	1506.9	1506.9	1507.2	1507.2	1506.3	1506.0	1506.3	1506.5
10	06.1	06.1	05.8	05.8	05.2	05.5	05.5	05.8
20	06.0	06.0	05.6	05.6	05.3	05.3	05.6	05.6
30	06.1	05.8	05.8	05.5	05.2	05.5	05.5	05.5
50	06.2	05.8	05.5	05.5	05.5	05.8	05.5	05.5
75	05.9	05.9	05.9	06.2	05.9	05.9	05.9	05.9
100	06.8	06.5	06.5	06.5	06.5	06.5	05.8	06.1
125	05.4	05.2	05.2	04.7	04.0	04.7	02.6	04.0
150	01.1	01.8	01.8	01.4	1497.7	1499.7	1498.6	00.0
200	1492.3	1492.3	1493.0	1492.3	92.3	93.0	92.6	1492.3
SC	0	0	0	0	0	0	0	0
DC	20	40	20	40	10	20	10	40
MAX	100	100	30	107	20	96	90	85
DC	75		50		30			
MAX	100		107		100			

Table A-2, continued.

TELETHERM BUOY MEASUREMENTS

Depth, m	2030	2130	Buoy 2 1830
0	1506.6	1507.2	1508.5
10	06.1	06.8	06.8
20	06.3	06.9	06.3
30	06.1	07.1	06.1
50	05.8	07.1	06.5
75	06.2	06.6	05.2
100	06.1	06.1	04.4
125	01.6	00.9	00.9
150	1498.3	1497.2	
200	91.9	91.6	
SC	0	0	0
DC	10	10	30
MAX	20	100	50
DC	50		
MAX	95		

Table A-3. Average Sound-Speed Profile (m/sec),
Station 3 Run 1 (19 February 1972 1500-2130 LST).

Depth,	Profile 1 1510-1612			Profile 2 1612-1638			Profile 3 1638-2130		
m	n	$\overline{C}$	σ	n	$\overline{C}$	σ	n	$\overline{C}$	σ
0	378	1506.57	0.29	144	1507.27	0.19	1755	1506.48	0.45
10	378	05.96	0.13	144	06.96	0.11	1755	05.76	0.49
20	378	05.83	0.13	144	05.99	0.07	1755	05.73	0.49
30	378	06.01	0.13	144	06.11	0.07	1755	05.82	0.49
50	378	06.22	0.26	144	06.22	0.10	1755	05.83	0.49
75	378	06.58	0.20	144	06.54	0.10	1755	06.11	0.17
100	378	04.79	0.31	144	06.14	0.47	1755	06.30	0.47
125	378	04.50	0.24	144	05.49	0.58	1755	03.58	1.13
150	378	02.25	1.01	144	01.28	0.32	1755	1499.64	1.26
200	378	1492.84	0.39	144	1492.59	0.18	1755	92.02	0.54
250	378	89.73	0.15	144	89.54	0.23	1755	89.16	0.72
300	13	86.29	0.72						
400	13	83.23	0.60						
500	9	81.81	0.29						
600	5	81.36	0.36						
800	4	81.25	0.15						
1000	4	82.17	0.22						
1200	4	83.47	0.22						
1500	4	86.06	0.22						
17		1505.80			1505.95				DC
28								1505.60	DC
75		1506.58							MAX
79					1506.60				MAX
101								1506.35	MAX
110		1504.00							DC
135		1504.80							MAX
700		1481.20			1481.20			1481.20	AXIS

Table A-4. Average Thermistor Chain Temperature, Station 3 Run 1, **Profile 1** (number of measurements at each depth: 378).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.17	15.60	15.59	0.092
6	15.05	15.27	15.18	0.053
11	14.97	15.20	15.13	0.038
17	14.92	15.20	15.09	0.038
23	14.95	15.20	15.08	0.038
28	14.92	15.15	15.07	0.037
34	14.95	15.10	15.04	0.031
39	14.92	15.15	15.06	0.039
45	14.87	15.12	15.03	0.037
51	14.72	15.07	14.96	0.082
56	14.95	15.10	15.04	0.034
62	14.77	15.12	15.04	0.038
68	14.92	15.10	15.04	0.036
73	14.82	15.10	15.01	0.051
79	14.72	15.20	14.94	0.093
85	14.37	14.97	14.73	0.148
90	14.25	14.90	14.47	0.146
96	14.17	14.70	14.35	0.099
101	14.00	14.40	14.25	0.089
107	13.97	14.40	14.18	0.101
113	13.97	14.35	14.15	0.097
118	13.95	14.25	14.09	0.055
124	13.90	14.25	14.06	0.067
130	13.82	14.22	14.02	0.071
135	13.70	14.15	13.93	0.100
141	13.55	14.12	13.80	0.137
147	13.15	13.72	13.49	0.107
152	12.60	13.55	13.03	0.292
158	12.32	12.97	12.73	0.128
164	11.87	12.72	12.36	0.218
169	11.42	12.20	11.79	0.161
175	11.12	11.77	11.56	0.173
180	10.82	11.60	11.26	0.178
186	10.55	11.20	10.95	0.140
192	10.32	10.97	10.67	0.157
197	9.97	10.65	10.39	0.145
203	9.97	10.30	10.13	0.081
209	9.85	10.22	10.04	0.089
214	9.77	10.05	9.88	0.056
220	9.52	9.90	9.69	0.084
226	9.32	9.70	9.51	0.086
231	9.20	9.52	9.34	0.064
237	9.15	9.40	9.26	0.039
242	9.02	9.25	9.17	0.044

Table A-4, continued. **Profile 2** (number of measurements at each depth: 144).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.47	15.77	15.61	0.064
6	15.17	15.30	15.25	0.030
11	15.10	15.25	15.16	0.029
17	15.05	15.15	15.11	0.019
23	15.05	15.15	15.10	0.017
28	15.07	15.12	15.10	0.016
34	15.00	15.10	15.05	0.020
39	15.02	15.12	15.08	0.025
45	14.97	15.10	15.04	0.029
51	14.92	15.07	15.01	0.029
56	14.95	15.10	15.04	0.031
62	14.95	15.10	15.03	0.035
68	14.92	15.10	15.02	0.035
73	14.90	15.05	15.00	0.028
79	14.90	15.05	14.98	0.037
85	14.80	15.02	14.93	0.056
90	14.57	15.00	14.86	0.112
98	14.45	14.97	14.78	0.143
101	14.32	14.87	14.66	0.141
107	14.35	14.85	14.63	0.161
113	14.15	14.82	14.50	0.230
118	14.07	14.75	14.39	0.245
124	14.10	14.62	14.35	0.167
130	14.05	14.47	14.18	0.114
135	13.40	14.00	13.67	0.153
141	13.85	13.62	13.27	0.169
147	12.87	13.47	13.15	0.167
152	12.57	13.00	12.75	0.092
158	12.12	12.60	12.42	0.120
164	11.70	12.45	11.97	0.167
169	11.52	11.95	11.66	0.098
175	11.27	11.57	11.40	0.063
180	10.85	11.22	11.07	0.088
186	10.42	10.77	10.61	0.073
192	10.27	10.42	10.35	0.034
197	10.05	10.35	10.22	0.089
203	10.00	10.20	10.12	0.047
209	9.77	10.07	9.97	0.072
214	9.62	9.87	9.77	0.062
220	9.47	9.72	9.63	0.069
226	9.37	9.55	9.47	0.038
231	9.22	9.40	9.31	0.034
237	9.10	9.32	9.25	0.046
242	9.05	9.25	9.15	0.056

Table A-4, continued. **Profile 3** (number of measurements at each depth: 1755).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.05	15.65	15.36	0.138
6	14.67	15.55	15.14	0.149
11	14.82	15.45	15.08	0.148
17	14.77	15.42	15.04	0.150
23	14.80	15.42	15.02	0.148
28	14.80	15.45	15.01	0.149
34	14.77	15.37	14.96	0.147
39	14.77	15.42	14.98	0.145
45	12.42	15.40	14.93	0.151
51	14.70	15.40	14.89	0.123
56	14.47	17.82	14.90	0.116
62	14.75	15.20	14.89	0.074
68	12.35	15.27	14.87	0.088
73	14.72	15.10	14.86	0.058
79	14.72	15.02	14.86	0.052
85	14.70	14.97	14.84	0.048
90	14.60	15.07	14.82	0.062
96	14.55	15.00	14.79	0.079
101	14.17	14.95	14.71	0.143
107	13.97	15.37	14.53	0.218
113	13.72	15.00	14.28	0.254
118	13.22	14.60	14.02	0.291
124	12.92	14.37	13.80	0.335
130	12.75	14.45	13.52	0.330
135	12.27	14.05	13.23	0.327
141	12.07	13.72	12.91	0.323
147	11.80	13.27	12.67	0.315
152	11.37	13.00	12.30	0.355
158	11.12	12.75	11.97	0.302
164	10.60	12.37	11.60	0.327
169	10.45	12.05	11.22	0.343
175	10.35	11.57	10.88	0.280
180	10.25	11.27	10.65	0.218
186	10.12	11.05	10.44	0.187
192	9.97	10.70	10.27	0.160
197	9.80	10.52	10.10	0.167
203	9.65	10.40	9.95	0.147
209	9.32	10.10	9.80	0.130
214	9.27	9.90	9.65	0.138
220	9.17	9.82	9.53	0.143
226	8.90	9.72	9.39	0.161
231	8.80	9.60	9.24	0.185
237	8.67	9.50	9.15	0.185

Table A-5. Standard Deviation (cm) of Wave Height for 3-Min Averages, Station 3 Run 1 (19 February 1972 1500-2130 LST).

	Hours					
Minutes	1600	1700	1800	1900	2000	2100
00		42	41	36	45	41
03		55	44	45	44	38
06		50	33	28	40	51
09		42	51	66	51	47
12		51	38	26	37	49
15	49	52	27	35	39	47
18	52	38	52	35	50	48
21	46	36	42	50	55	53
24	38	58	44	47	59	53
27	48	46	34	40	54	43
30	49	43	54	49	40	
33	54	35	42	41	44	
36	47	34	49	49	46	
39	40	45	46	49	38	
42	49	49	45	46	42	
45	35	40	45	55	41	
48	50	43	45	44	27	
51	43	48	39	37	45	
54	47	40	56	49	45	
57	48	44	38	54	42	

Table A-6. Standard Deviation of Wave Height as a Function of Wave Period.

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
1.2 – 1.4	2.5	7.5 – 7.7	4.7
1.5 – 1.9	3.5	7.8 – 8.1	4.9
2.0 – 2.4	3.4	8.2 – 8.5	5.7
2.5 – 2.9	2.7	8.6 – 8.9	6.2
3.0 – 3.4	2.5	9.0 – 9.4	7.7
3.5 – 3.9	2.4	9.5 – 9.9	7.5
4.0 – 4.4	3.0	10.0 – 10.5	9.5
4.5 – 4.9	3.1	10.6 – 11.2	10.0
5.0 – 5.4	3.3	11.3 – 11.9	13.0
5.5 – 5.9	4.3	12.0 – 12.8	17.6
6.0 – 6.4	4.6	12.9 – 13.8	18.9
6.5 – 6.9	5.3	13.9 – 14.9	20.0
7.0 – 7.4	5.9	15.0 – 16.3	10.4
		16.4 – 17.7	6.2

APPENDIX B

STATION 3 RUN 2

DETAILED ENVIRONMENTAL DATA SUMMARY

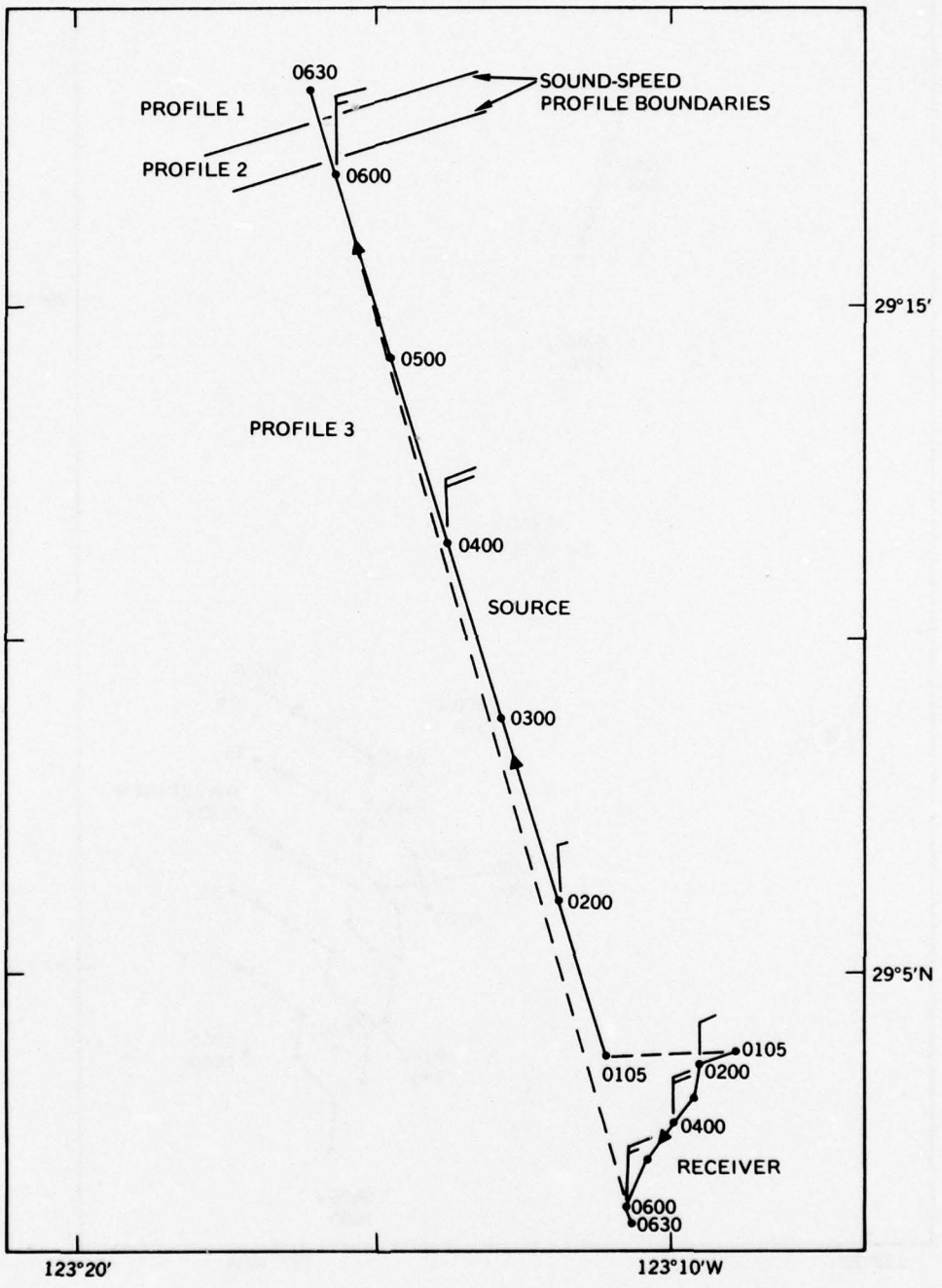


Figure B-1. Station 3, run 2. Location of source and receiver ships, 0105 and 0630 LST propagation paths (---), and wind velocity (•——\\ 10-knot east wind, 1 bar = 5 knots).

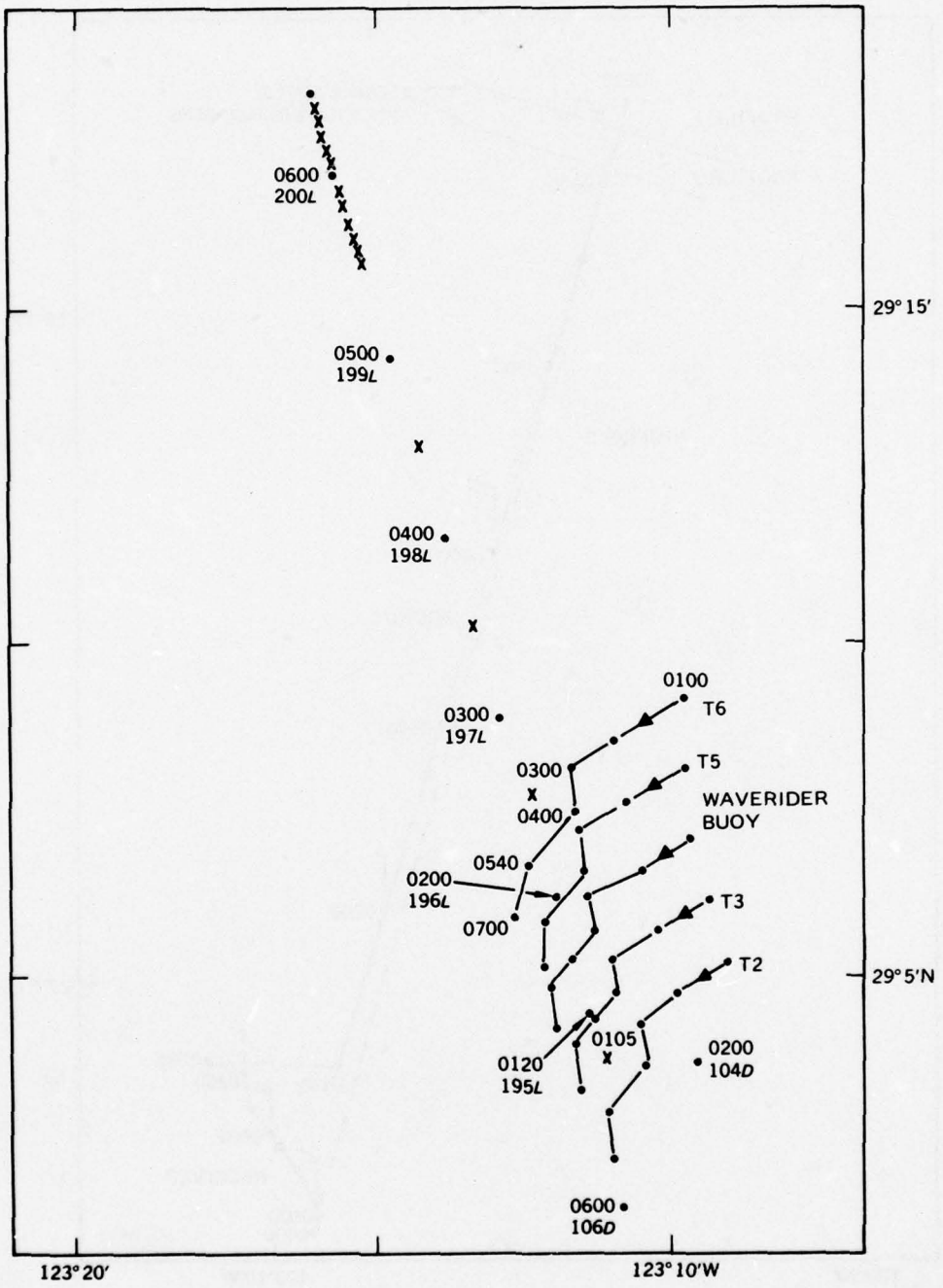


Figure B-2. Location of XBT (·), thermistor chain (X), Teletherm buoy (T), and Waverider buoy measurements. The letter following the XBT number denotes the ship which took the measurements (*L: Lee, D: DeSteiguer).* Times shown are LST.

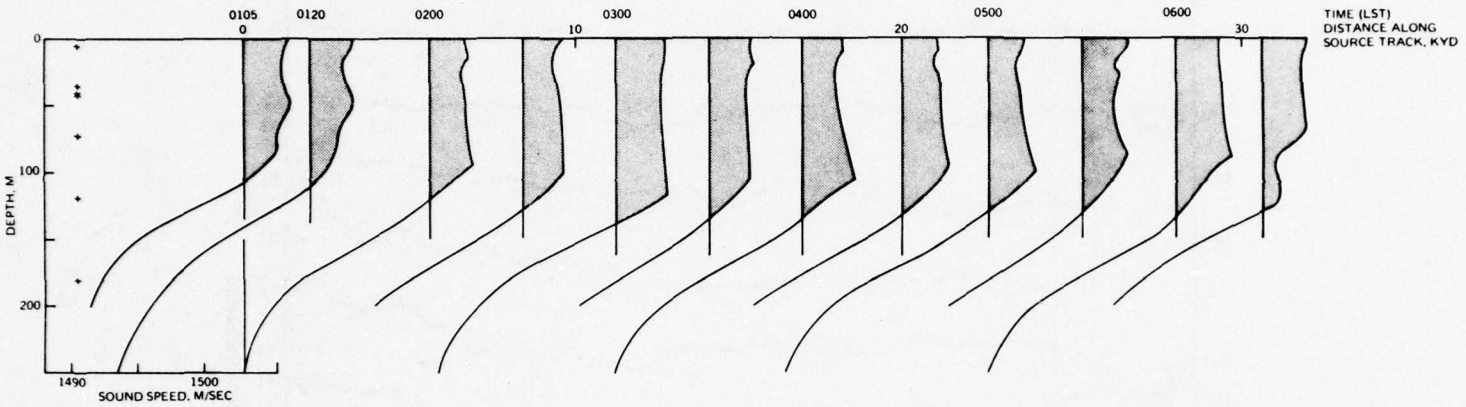


Figure B-3. Station 3, run 2. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depth (+).

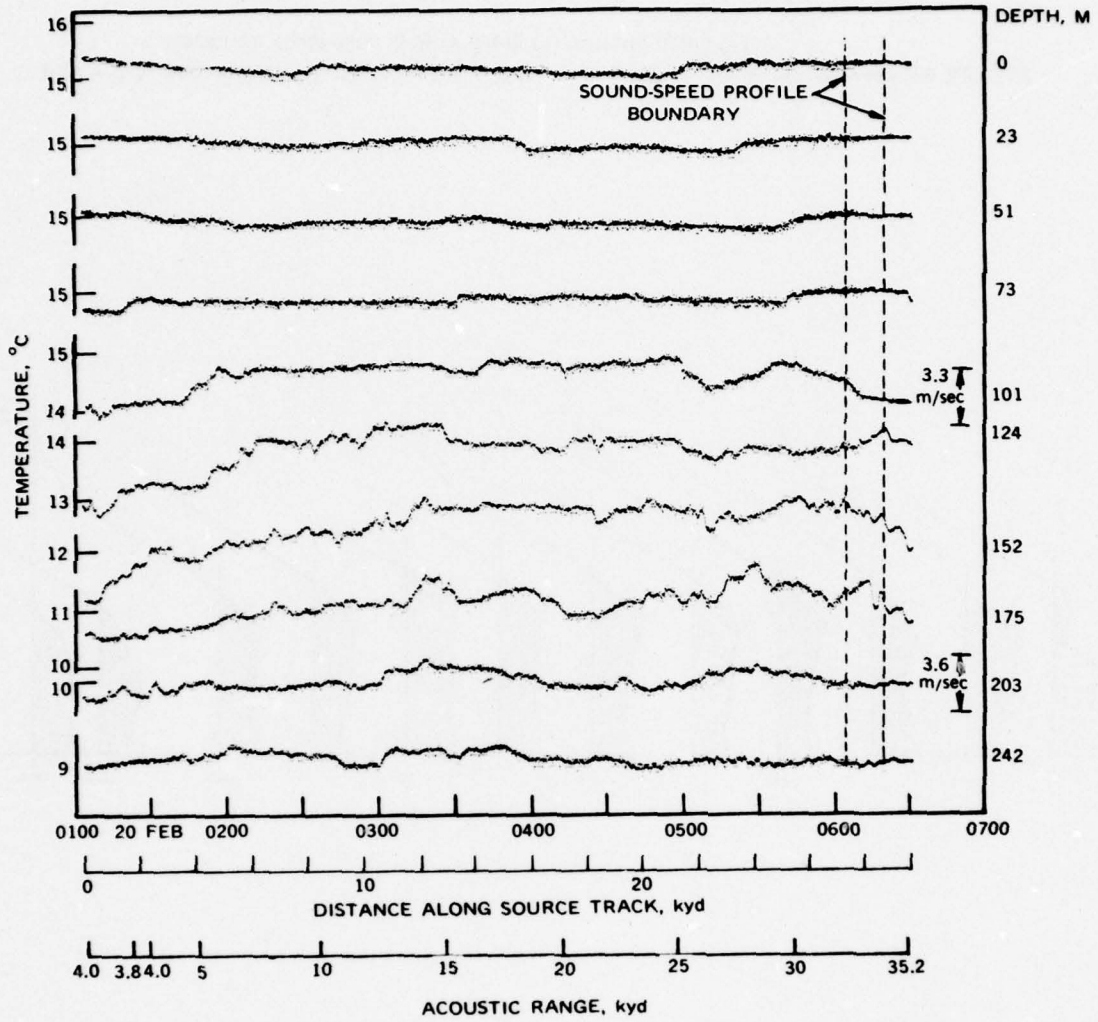


Figure B-4. Station 3, run 2. Thermistor chain temperature measurements at selected depths. Dotted lines indicate transition between two sound-speed profile shapes. *Time is LST.*

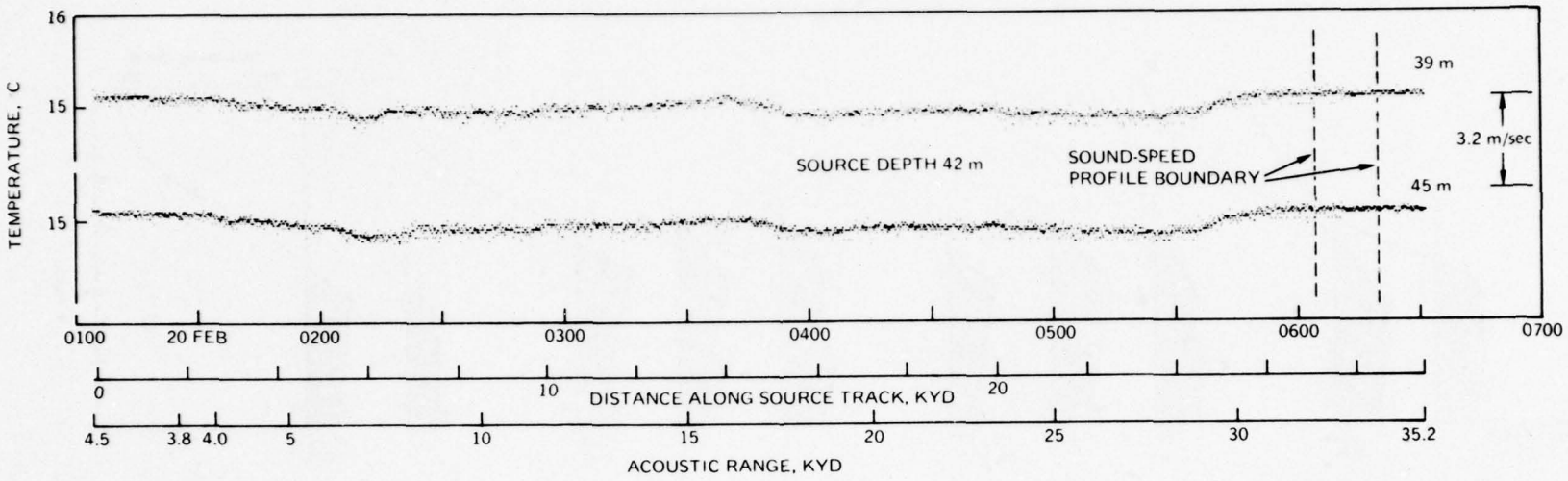


Figure B-5. Station 3, run 2. Temperatures above and below source. Time is LST.

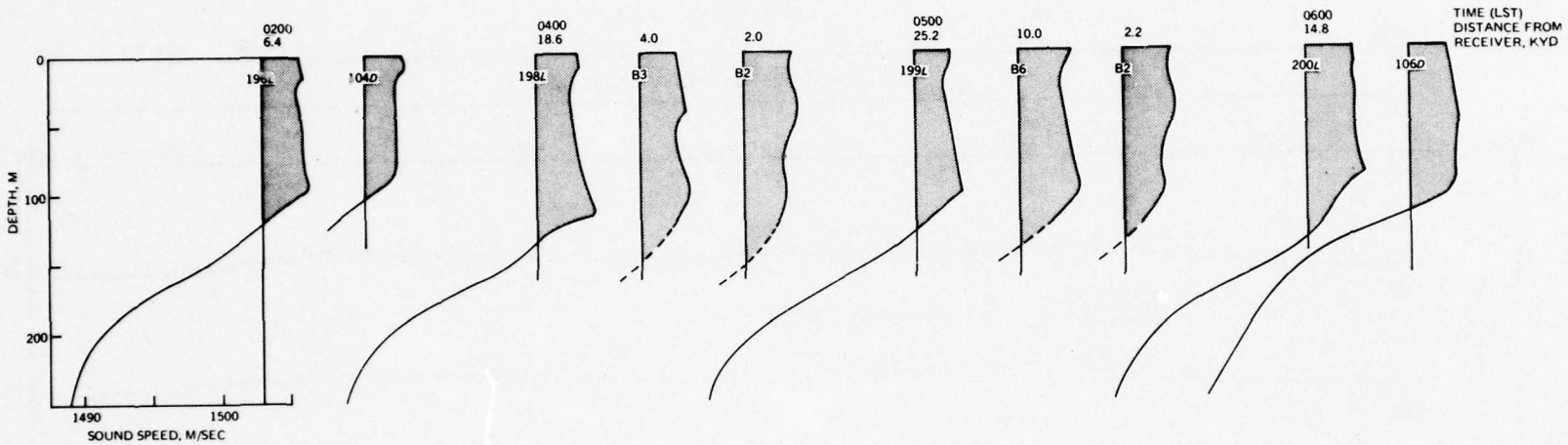


Figure B-6. Station 3, run 2. Spatial change in sound-speed profile.

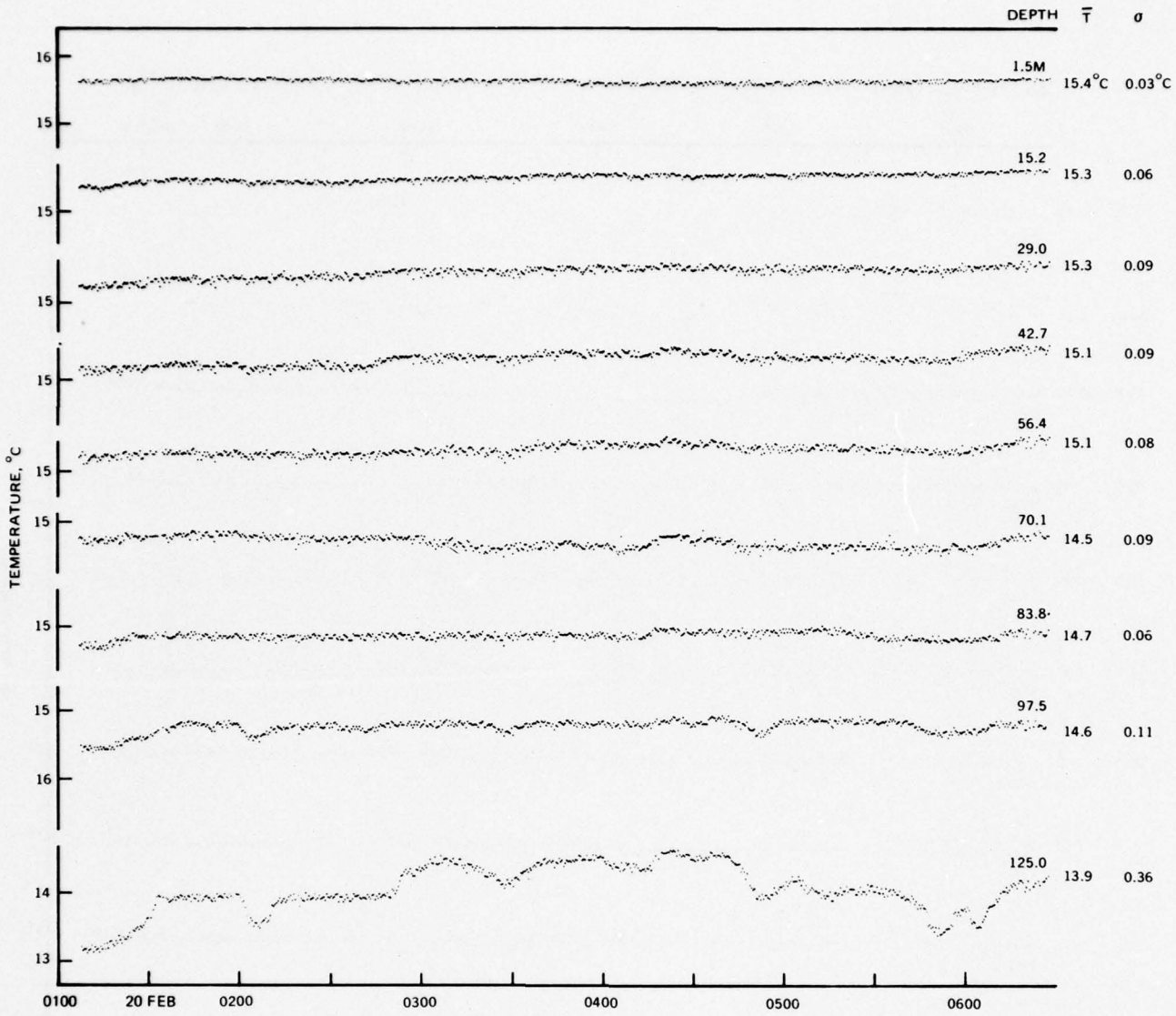


Figure B-7a. Station 3, run 2. Teletherm buoy 2 temperature measurements (n = 1877). Time is LST.

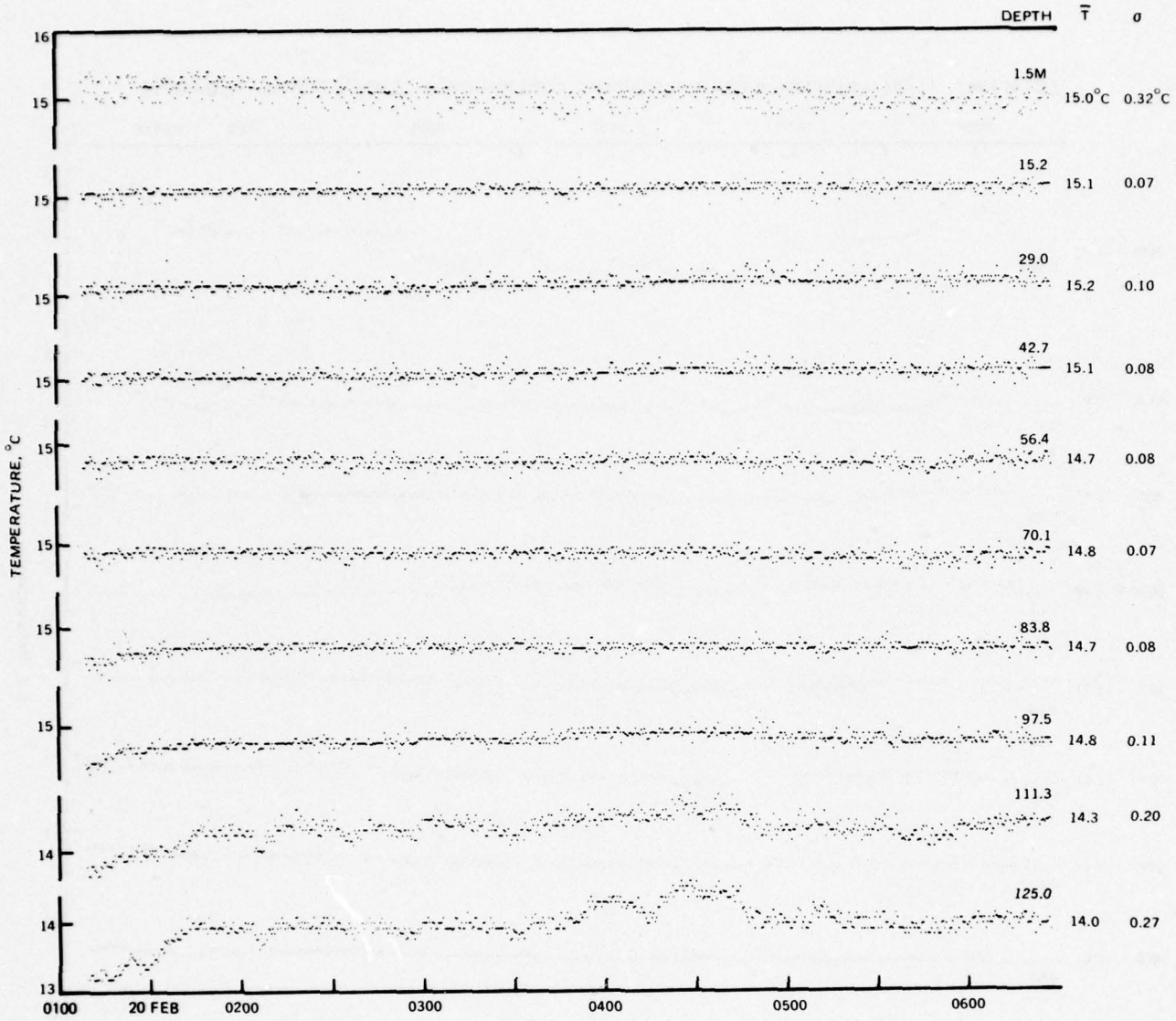


Figure B-7b. Station 3, run 2. Teletherm buoy 3 temperature measurements (n = 1865). Time is LST.

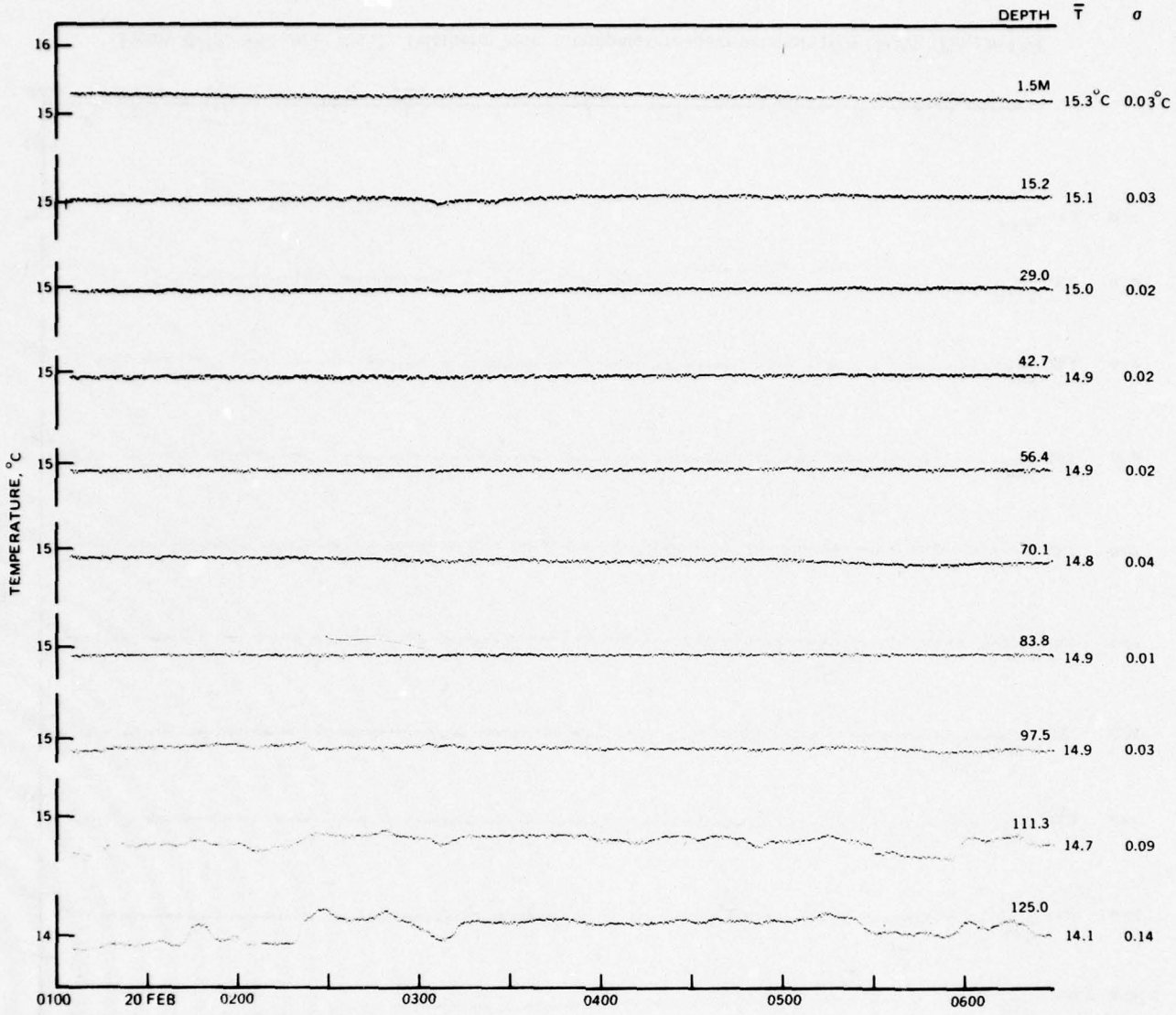


Figure B-7c. Station 3, run 2. Teletherm buoy 5 temperature measurements (n = 1931). Time is LST.

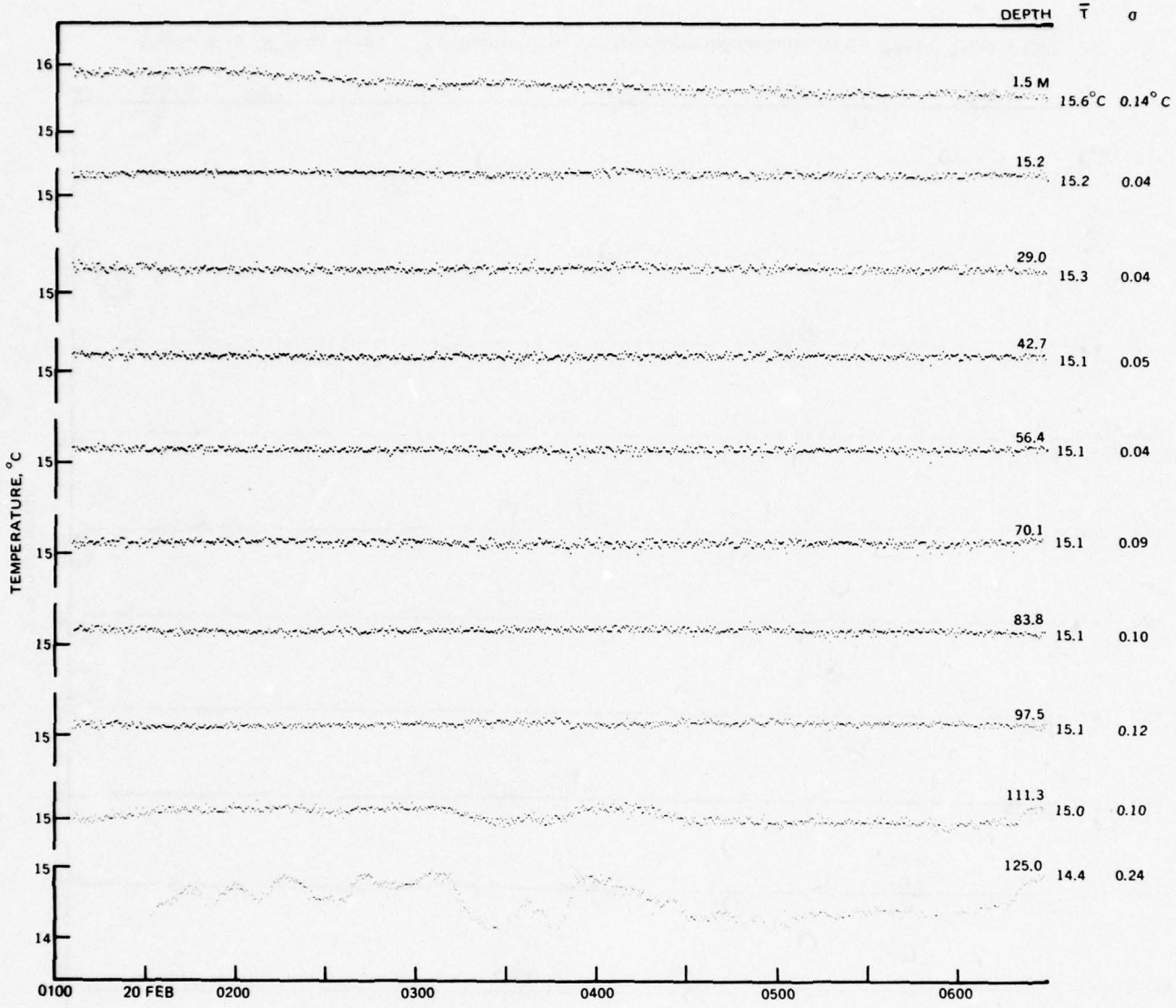


Figure B-7d. Station 3, run 2. Teletherm buoy 6 temperature measurements (n = 1806). Time is LST.

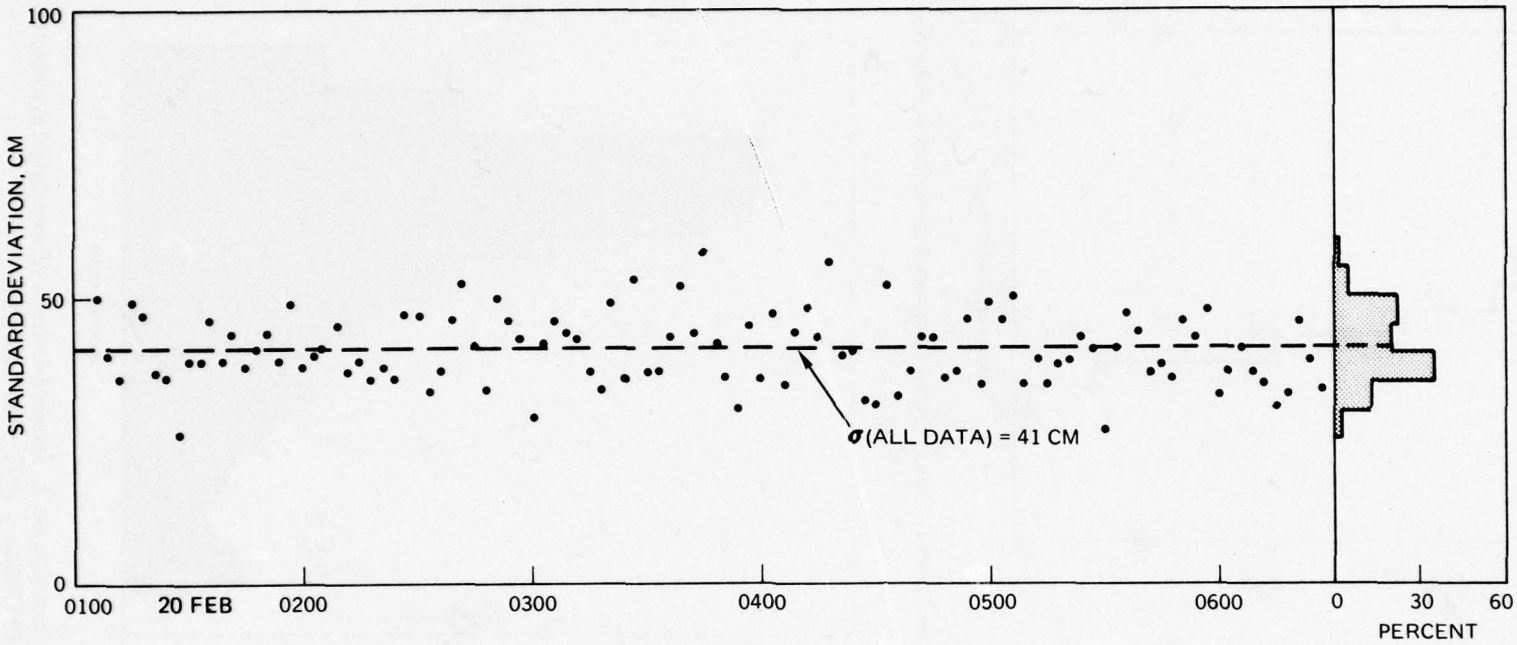


Figure B-8. Station 3 run 2. Standard deviation of surface-wave height for 3-min averages. Time is LST.

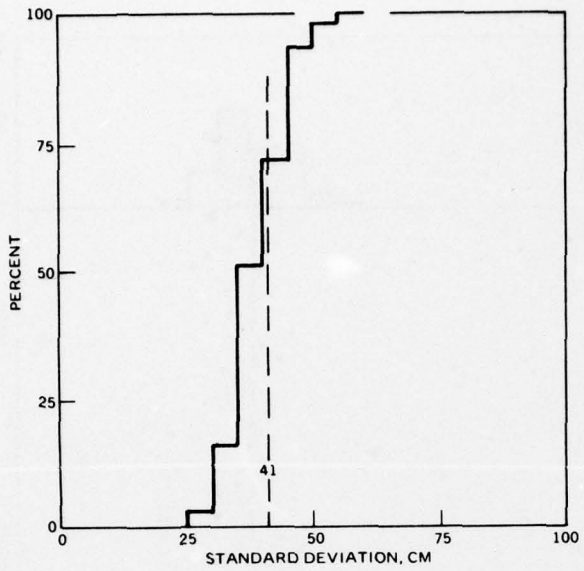


Figure B-9. Station 3, run 2. Ogive of standard deviation of surface-wave height for 3-min averages.

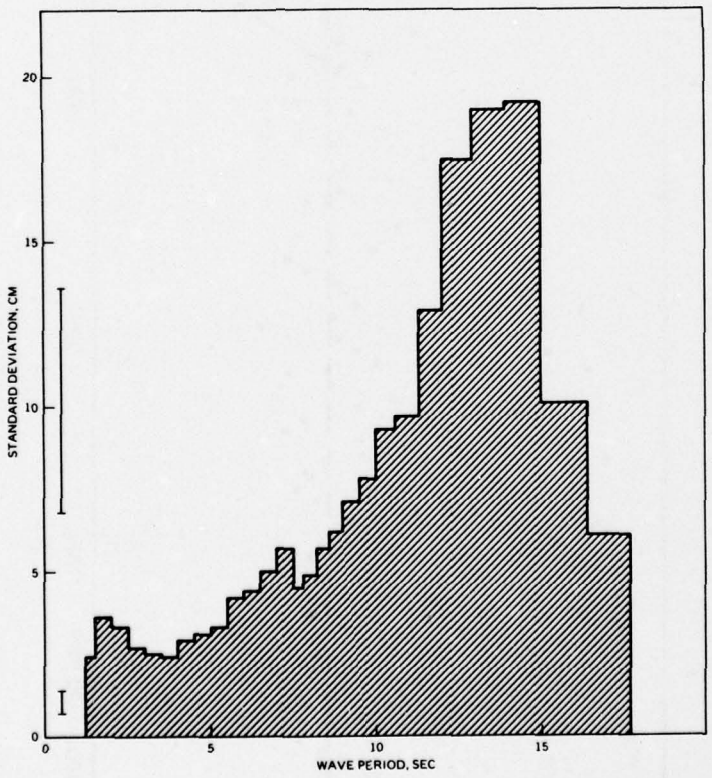


Figure B-10. Station 3, run 2. Standard deviation of wave height as a function of wave period (20 February 1972, 0110-0624 LST).

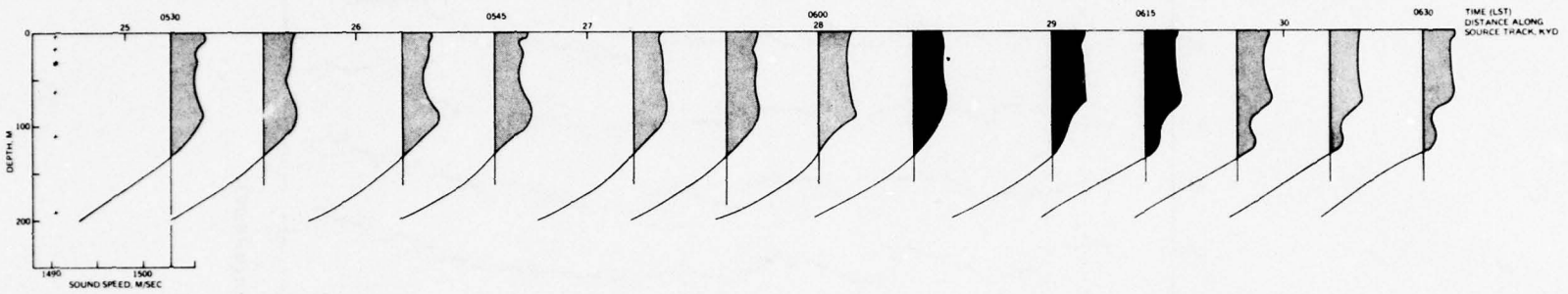


Figure B-11. Station 3, run 2. Expanded sound-speed profile plot.

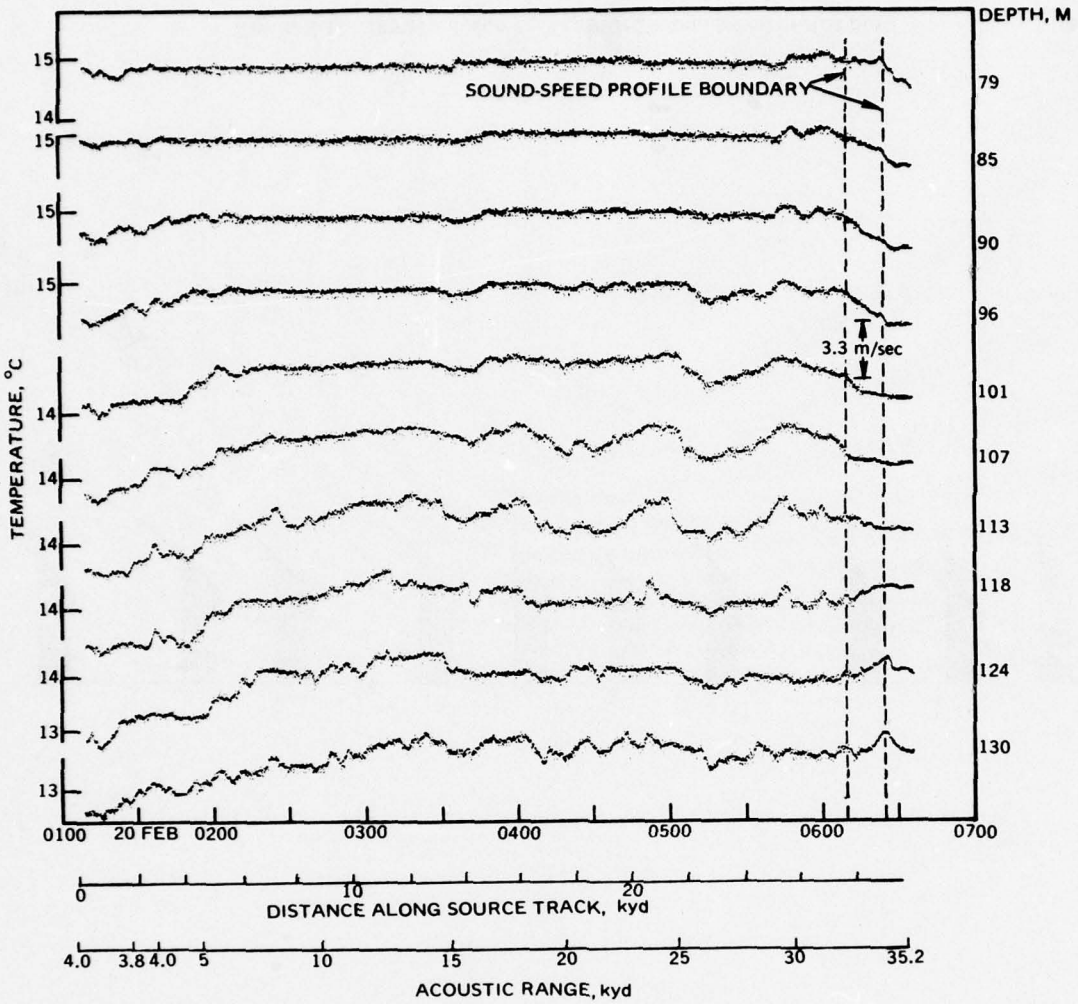


Figure B-12. Station 3, run 2. Thermistor chain temperature measurements at about 6-m depth intervals from 79 to 130 m. Dotted lines indicate transition between two sound-speed profile shapes. Time is *LST*.

Table B-1. Temperature Profiles (°C),
Station 3 Run 2 (20 February 1972 0105-0630 LST).

XBT MEASUREMENTS

Depth, m	195L 0120	196L 0200	197L 0300	198L 0400	199L 0500	200L 0600	104D 0200	106D 0600
0	15.3	15.1	15.4	15.2	15.1	15.3	15.1	15.1
10	15.2	15.1	15.4	15.2	15.0	15.3	15.1	15.1
20	15.0	15.0	15.3	15.0	14.8	15.2	14.9	15.1
30	15.0	14.9	15.2	14.9	14.8	15.2	14.8	15.1
50	15.0	14.9	15.1	14.9	14.8	15.1	14.7	15.1
75	14.6	14.8	15.0	14.9	14.8	15.1	14.6	14.9
100	14.1	14.6	14.9	14.9	14.8	14.6	13.9	14.7
125	13.0	13.4	14.4	13.9	13.7	13.9	12.8	13.0
150	11.6	12.3	12.8	12.9	12.6	12.9		11.3
200	9.8	9.8	10.2	10.1	9.8	10.1		9.8
250	8.8	8.9	9.1	8.9	8.6	8.9		8.7
300	7.9	7.9	8.0	7.9	7.8	7.9		8.0
400	6.5	6.6	6.8	6.9	6.4	6.8		6.9
ILD	0	18	10	10	0	10	10	50
T	15.3	15.1	15.4	15.2	15.1	15.3	15.1	15.1
SLD	95	95	120	105	100	90	85	100

THERMISTOR CHAIN MEASUREMENTS

Depth, m	0105	0230	0330	0430	0530	0535	0540	0545	0550	0555
0	15.4	15.2	15.3	15.1	15.3	15.3	15.4	15.3	15.3	15.3
10	15.2	15.0	15.2	15.1	15.3	15.2	15.1	15.1	15.1	15.3
20	15.1	14.9	15.2	14.9	15.0	15.1	15.1	15.1	15.1	15.1
30	15.1	14.9	15.0	15.0	15.0	15.0	15.0	15.0	15.1	15.4
50	15.1	14.9	14.9	14.9	14.8	14.8	14.7	14.8	15.0	15.0
75	14.7	14.8	14.8	14.9	14.8	14.9	14.8	15.0	15.0	15.0
100	14.1	14.7	14.7	14.8	14.6	14.7	14.8	14.8	14.7	14.6
125	12.8	13.8	13.9	13.9	13.8	13.8	13.8	13.7	13.7	13.8
150	11.2	12.5	12.9	12.7	12.7	12.8	12.8	12.9	12.9	13.0
200	9.9	10.0	10.4	10.0	10.3	10.3	10.3	10.2	10.2	10.2
ILD	0	0	0	11	6	0	6	6	0	11
T	15.4	15.2	15.3	15.1	15.3	15.3	15.3	15.4	15.3	15.3
SLD	85	101	107	101	90	85	90	85	75	79

Table B-1, continued.

Depth, m	0600	0605	0610	0615	0620	0625	0630
0	15.3	15.2	15.3	15.3	15.3	15.3	15.3
10	15.2	15.2	15.2	15.2	15.2	15.2	15.2
20	15.1	15.2	15.1	15.1	15.1	15.1	15.1
30	15.1	15.1	15.1	15.1	15.1	15.1	15.1
50	15.0	15.0	15.0	15.0	15.0	15.0	15.0
75	15.0	15.0	15.0	15.1	15.1	14.9	14.8
100	14.6	14.6	15.3	14.2	14.2	14.1	14.1
125	13.7	13.9	13.9	14.0	14.1	13.9	13.9
150	12.9	12.9	12.8	12.7	12.7	12.6	12.9
200	10.0	10.1	10.1	9.9	10.0	10.0	10.0
ILD	0	23	6	6	6	6	6
T	15.3	15.2	15.3	15.3	15.3	15.3	15.3
SLD	75	75	75	75	118	118	118

TELETHERM BUOY MEASUREMENTS

Depth, m	Buoy 2 0400	Buoy 3 0400	Buoy 2 0500	Buoy 6 0500
0	15.4	15.1	15.4	15.5
10	15.3	15.1	15.3	15.3
20	15.3	15.1	15.3	15.1
30	15.3	15.1	15.3	15.1
50	15.2	14.9	15.2	15.1
75	14.8	14.8	14.8	15.1
100	14.7	14.8	14.7	15.1
125	14.3	14.3	14.0	14.2
ILD	0	43	0	0
T	15.4	15.1	15.4	15.5
SLD	100	100	100	100

Table B-2. Computed Sound-Speed Profiles (m/sec), Station 3 Run 2 (20 February 1972 0105-0630 LST).

XBT MEASUREMENTS

Depth, m	195L 0120	196L 0200	197L 0300	198L 0400	199L 0500	200L 0600	104D 0200	106D 0600
0	1506.3	1505.6	1506.6	1506.0	1505.6	1506.3	1505.6	1505.6
10	06.1	05.8	06.8	06.1	05.5	06.4	05.8	05.8
20	05.6	05.6	06.6	05.6	05.0	06.3	05.3	06.0
30	05.8	05.5	06.5	05.5	05.2	06.5	05.2	06.1
50	06.2	05.8	06.5	05.8	05.5	06.5	05.2	06.5
75	05.2	05.9	06.6	06.2	05.9	06.9	05.2	06.2
100	04.1	05.8	06.8	06.8	06.5	05.8	03.4	06.1
125	00.9	02.3	05.7	04.0	03.3	04.0	00.2	00.9
150	1496.5	1499.0	00.7	01.1	00.0	01.1		1495.5
200	91.2	91.2	1492.6	1492.3	1491.2	1492.3		91.2
250	88.6	89.0	89.7	89.0	87.8	89.0		88.2
300	86.2	86.2	86.5	86.2	85.8	86.2		86.5
400	82.4	82.9	83.7	84.1	85.0	83.7		84.1
SC	0	18	10	10	0	10	10	50
DC	20	30	30	30	20	20		
MAX	50	95	120	105	100	90		

THERMISTOR CHAIN MEASUREMENTS

Depth, m	0105	0230	0330	0430	0530	0535	0540	0545
0	1506.6	1506.0	1506.3	1505.6	1506.3	1506.3	1506.1	1506.5
10	06.1	05.5	06.1	05.8	06.4	06.0	05.8	05.6
20	06.0	05.3	06.3	05.3	05.6	05.9	05.9	05.9
30	06.1	05.5	05.8	05.8	05.8	05.9	05.7	05.9
50	06.5	05.8	05.8	05.8	05.5	05.5	05.1	05.6
75	05.6	05.9	05.9	06.2	05.9	06.2	06.0	06.6
100	04.1	06.1	06.1	06.5	05.8	06.2	06.5	06.5
125	00.2	03.6	04.0	04.0	03.6	03.6	03.6	03.4
150	1495.1	1499.7	01.1	00.4	00.4	00.7	00.9	01.1
200	91.6	91.9	1493.3	1491.9	1493.0	1492.8	1492.8	1492.7
SC	0	0	0	11	6	0	6	6
DC	20	20	10	10	20	50	10	10
MAX	50	101	20	101	30	86	20	25
DC			40		50		50	50
MAX			107		90		90	85

Table B-2, continued.

Depth, m	0550	0555	0600	0605	0610	0615	0620
0	1506.3	1506.3	1506.3	1505.9	1506.3	1506.3	1506.3
10	05.7	06.3	06.2	06.2	06.2	06.1	06.2
20	06.0	06.0	06.0	06.2	06.0	06.1	06.0
30	06.1	06.3	06.0	06.1	06.2	06.1	06.0
50	06.1	06.1	06.3	06.1	06.2	06.2	06.2
75	06.6	06.5	06.7	06.6	06.5	06.8	06.7
100	06.0	05.9	05.7	05.7	04.8	04.6	04.4
125	03.4	03.8	03.4	04.0	03.8	04.3	04.8
150	01.1	01.2	01.2	01.0	00.8	00.3	00.5
200	1492.6	1492.6	1491.9	1492.2	1492.1	1491.7	1492.8
SC	0	11	0	23	6	6	6
DC	10	20	28	40	20	20	25
MAX	75	30	75	75	75	75	75
DC		50					107
MAX		79					118

Depth, m	0625	0630
0	1506.2	1506.3
10	06.1	06.1
20	06.1	06.0
30	06.1	06.1
50	06.1	06.2
75	06.4	05.9
100	04.2	04.1
125	04.0	04.0
150	00.0	1499.0
200	1492.0	91.9
SC	6	6
DC	25	20
MAX	75	79
DC	107	107
MAX	118	118

Table B-2, *continued.*

TELETHERM BUOY MEASUREMENTS

Depth, m	Buoy 2 0400	Buoy 3 0400	Buoy 2 0500	Buoy 6 0500
0	1506.6	1505.6	1506.6	1506.9
10	06.4	05.8	06.4	06.4
20	06.6	06.0	06.6	06.0
30	06.8	06.1	06.8	06.1
50	06.8	05.8	06.8	06.5
75	05.9	05.9	05.9	06.9
100	06.1	06.5	06.1	07.5
125	05.4	05.4	04.3	05.0
SC	0	43	0	0
DC	10	60	10	20
MAX	40	100	40	100
DC	75		75	
MAX	100		100	

Table B-3. Average Sound-Speed Profile (m/sec),
Station 3 Run 2 (20 February 1972 0105-0630 LST).

Depth, m	Profile 1 0616-0630			Profile 2 0606-0616			Profile 3 0105-0606		
	n	$\bar{C}$	σ	n	$\bar{C}$	σ	n	$\bar{C}$	σ
0	90	1506.22	0.06	54	1506.22	0.10	1809	1505.90	0.29
10	90	06.09	0.10	54	05.99	0.10	1809	05.80	0.26
20	90	06.02	0.61	54	05.99	0.07	1809	05.70	0.29
30	90	06.11	0.07	54	06.07	0.10	1809	05.78	0.29
50	90	06.16	0.07	54	06.32	0.10	1809	05.76	0.26
75	90	06.24	0.57	54	06.58	0.14	1809	06.08	0.24
100	90	04.28	0.10	54	04.96	0.43	1809	05.97	0.84
125	90	04.30	0.31	54	03.99	0.27	1809	03.48	1.20
150	90	00.20	0.56	54	00.79	0.42	1809	1499.96	1.40
200	90	1491.92	0.11	54	1492.06	0.11	1809	92.31	0.57
250	90	88.98	0.12	54	88.98	0.12	1809	89.35	0.38
300	11	86.10	0.36						
400	11	83.15	0.65						
500	9	81.81	0.29						
600	5	81.36	0.36						
800	4	81.25	0.15						
1000	4	82.17	0.22						
1200	4	83.47	0.22						
1500	4	86.06	0.22						
6		1506.40			1506.35			1506.05	SC
15					1505.95				DC
20		1506.02						1505.70	DC
65		1506.40							MAX
75					1506.58				MAX
90								1506.40	MAX
101		1504.30							DC
107					1504.20				DC
113					1504.30				MAX
118		1504.80							MAX
700		1481.20			1481.20			1481.20	AXIS

Table B-4. Average Thermistor Chain Temperatures, Station 3 Run 2, **Profile 1** (number of measurements at each depth: 90).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.22	15.32	15.28	0.023
6	15.22	15.32	15.27	0.023
11	15.12	15.25	15.18	0.028
17	15.10	15.17	15.13	0.021
23	15.07	15.17	15.11	0.017
28	15.07	15.12	15.10	0.015
34	15.02	15.10	15.07	0.016
39	15.05	15.17	15.09	0.022
45	15.02	15.12	15.08	0.020
51	15.95	15.02	14.99	0.016
56	15.05	15.10	15.07	0.017
62	15.05	15.10	15.07	0.017
68	14.57	14.87	14.69	0.052
73	14.82	15.07	14.99	0.048
79	14.42	14.95	14.70	0.165
85	14.30	14.62	14.43	0.114
90	14.17	14.42	14.28	0.071
96	14.12	14.35	14.20	0.072
101	14.10	14.20	14.14	0.028
107	14.07	14.20	14.13	0.026
113	14.10	14.17	14.14	0.020
118	14.22	14.32	14.27	0.020
124	13.90	14.20	14.03	0.085
130	13.55	13.92	13.73	0.126
135	13.27	13.67	13.48	0.084
141	13.00	13.42	13.16	0.097
147	12.70	13.10	12.89	0.116
152	12.00	12.65	12.37	0.185
158	11.85	12.22	12.07	0.105
164	11.57	11.95	11.74	0.119
169	11.40	11.72	11.59	0.086
175	10.77	11.32	11.01	0.141
180	10.42	10.77	10.61	0.106
186	10.40	10.47	10.42	0.019
192	10.00	10.37	10.20	0.105
197	9.95	10.10	10.03	0.030
203	9.90	10.02	9.96	0.022
209	9.70	9.82	9.76	0.030
214	9.62	9.75	9.69	0.033
220	9.47	9.67	9.62	0.046
226	9.27	9.50	9.42	0.048
231	9.15	9.40	9.26	0.057
237	9.02	9.27	9.19	0.052
242	8.97	9.12	9.06	0.028

Table B-4, continued. **Profile 2** (number of measurements at each depth: 54).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.17	15.32	15.28	0.031
6	15.12	15.35	15.26	0.038
11	15.07	15.22	15.15	0.032
17	15.02	15.20	15.11	0.029
23	15.02	15.17	15.10	0.024
28	15.00	15.15	15.09	0.028
34	14.97	15.10	15.06	0.026
39	14.97	15.17	15.08	0.034
45	14.97	15.15	15.07	0.035
51	14.95	15.10	15.01	0.028
56	14.95	15.15	15.06	0.037
62	14.95	15.10	15.06	0.035
68	14.67	15.02	14.86	0.095
73	14.90	15.10	15.02	0.036
79	14.77	14.95	14.88	0.037
85	14.60	14.85	14.70	0.059
90	14.40	14.72	14.54	0.097
96	14.32	14.62	14.47	0.084
101	14.17	14.40	14.25	0.065
107	14.07	14.25	14.18	0.030
113	14.15	14.37	14.24	0.059
118	13.92	14.27	14.15	0.074
124	13.75	14.07	13.93	0.080
130	13.42	13.72	13.59	0.068
135	13.17	13.45	13.37	0.055
141	13.12	13.30	13.22	0.048
147	12.87	13.12	12.99	0.069
152	12.50	12.75	12.64	0.058
158	12.15	12.40	12.26	0.055
164	11.85	12.05	11.96	0.055
169	11.52	11.85	11.74	0.097
175	11.07	11.52	11.41	0.109
180	10.70	10.92	10.81	0.050
186	10.42	10.60	10.50	0.032
192	10.27	10.42	10.37	0.036
197	9.97	10.22	10.13	0.071
203	9.87	10.00	9.94	0.031
209	9.67	9.82	9.77	0.029
214	9.55	9.72	9.65	0.037
220	9.35	9.57	9.49	0.045
226	9.22	9.37	9.30	0.024
231	9.07	9.22	9.17	0.031
237	9.02	9.20	9.12	0.037
242	8.92	9.10	9.01	0.033

Table B-4, continued. **Profile 3** (number of measurements: 1809).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	14.92	15.40	15.18	0.091
6	14.87	15.40	15.16	0.086
11	14.85	15.30	15.09	0.079
17	14.77	15.20	15.03	0.086
23	14.77	15.20	15.01	0.088
28	14.75	15.20	15.00	0.089
34	14.72	15.15	14.95	0.088
39	14.72	15.20	14.96	0.088
45	14.72	15.15	14.93	0.086
51	14.65	15.10	14.87	0.084
56	14.72	15.15	14.89	0.070
62	14.70	15.15	14.88	0.065
68	14.42	15.05	14.82	0.101
73	14.60	15.10	14.85	0.079
79	14.62	15.07	14.86	0.071
85	14.65	15.00	14.84	0.064
90	14.37	15.00	14.80	0.102
96	14.15	14.95	14.73	0.144
101	13.82	14.95	14.60	0.246
107	13.47	14.87	14.45	0.310
113	13.32	14.80	14.23	0.338
118	13.12	14.60	13.98	0.320
124	12.62	14.35	13.78	0.354
130	12.47	13.95	13.46	0.328
135	11.87	13.67	13.16	0.370
141	11.72	13.42	12.90	0.344
147	11.35	13.20	12.73	0.369
152	11.07	12.97	12.44	0.418
158	10.92	12.80	12.18	0.426
164	10.67	12.60	11.82	0.424
169	10.57	12.27	11.46	0.394
175	10.37	11.85	11.10	0.294
180	10.22	11.32	10.85	0.217
186	10.17	11.00	10.61	0.184
192	10.07	10.90	10.45	0.163
197	9.77	10.72	10.20	0.154
203	9.62	10.42	10.01	0.156
209	9.52	10.20	9.83	0.160
214	9.32	10.02	9.66	0.151
220	9.17	9.87	9.56	0.135
226	9.07	9.80	9.43	0.141
231	8.97	9.57	9.28	0.118
237	8.87	9.45	9.19	0.102
242	8.85	9.35	9.10	0.102

Table B-5. Standard Deviation (cm) of Wave Height for 3-Min Averages, Station 3 Run 2 (20 February 1972 0105-0630 LST).

	Hours					
Minutes	0100	0200	0300	0400	0500	0600
02		39	42	46	46	36
05	49	45	45	34	50	40
08	39	45	44	44	34	37
11	35	37	43	48	39	35
14	48	38	36	42	35	31
17	47	35	34	56	38	32
20	37	38	48	39	39	45
23	36	35	36	40	43	38
26	25	46	53	32	40	33
29	38	47	36	30	26	
32	38	33	37	51	41	
35	46	36	42	32	46	
38	39	45	52	36	43	
41	44	52	43	42	36	
44	37	41	57	42	38	
47	41	34	42	36	35	
50	43	49	36	37	45	
53	39	46	30	45	43	
56	48	43	45	34	48	
59	37	29	36	48	33	

Table B-6. Standard Deviation of Wave Height as a Function of Wave Period.

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
1.2 – 1.4	2.4	7.5 – 7.7	4.5
1.5 – 1.9	3.6	7.8 – 8.1	4.9
2.0 – 2.4	3.3	8.2 – 8.5	5.7
2.5 – 2.9	2.7	8.6 – 8.9	6.2
3.0 – 3.4	2.5	9.0 – 9.4	7.1
3.5 – 3.9	2.4	9.5 – 9.9	7.8
4.0 – 4.4	2.9	10.0 – 10.5	9.3
4.5 – 4.9	3.1	10.6 – 11.2	9.7
5.0 – 5.4	3.3	11.3 – 11.9	12.9
5.5 – 5.9	4.2	12.0 – 12.8	17.5
6.0 – 6.4	4.4	12.9 – 13.8	19.0
6.5 – 6.9	5.0	13.9 – 14.9	19.2
7.0 – 7.4	5.7	15.0 – 16.3	10.1
		16.4 – 17.7	6.1

APPENDIX C

STATION 3 RUN 3

DETAILED ENVIRONMENTAL DATA SUMMARY

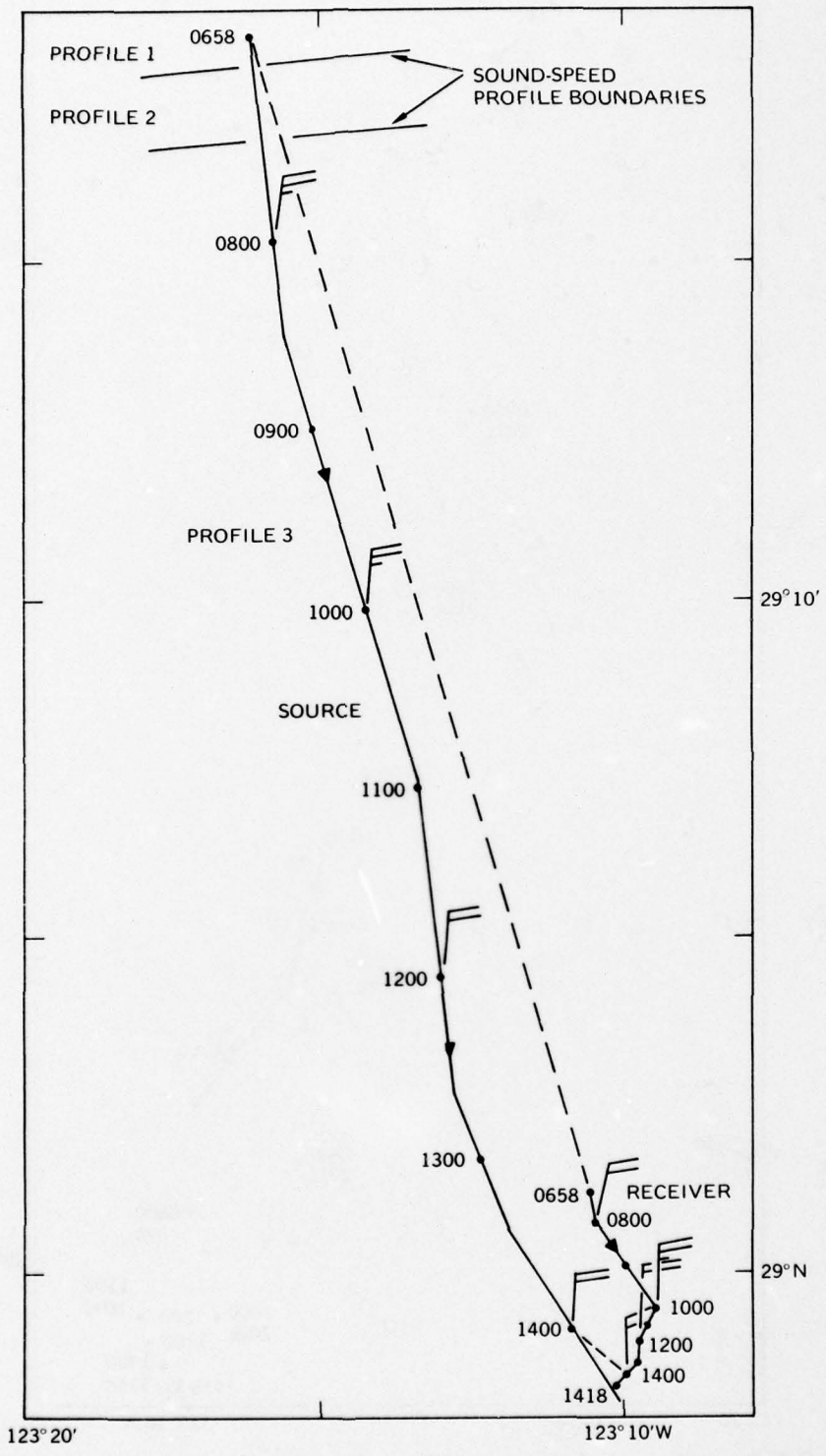


Figure C-1. Station 3, run 3. Location of source and receiver ships, 0658 and 1400 LST propagation paths (---), and wind velocity (•——\\10-knot east wind, 1 bar = 5 knots).

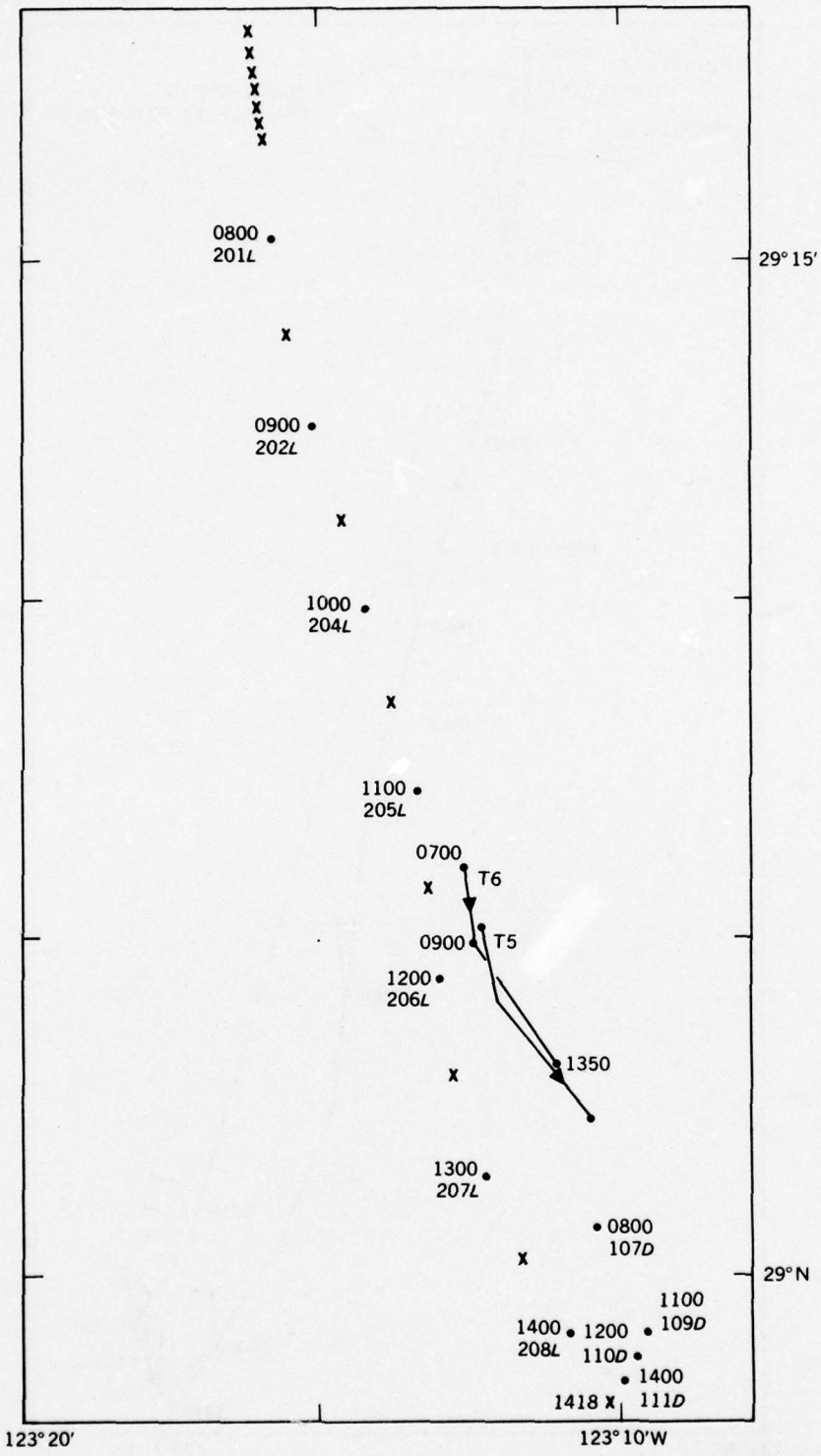


Figure C-2. Station 3, run 3. Location of XBT (·), thermistor chain (X), and teletherm buoy (T) measurements. The letter following the XBT number denotes the ship which took the measurement (*L: Lee, D: DeSteiguer).* Times shown are LST.

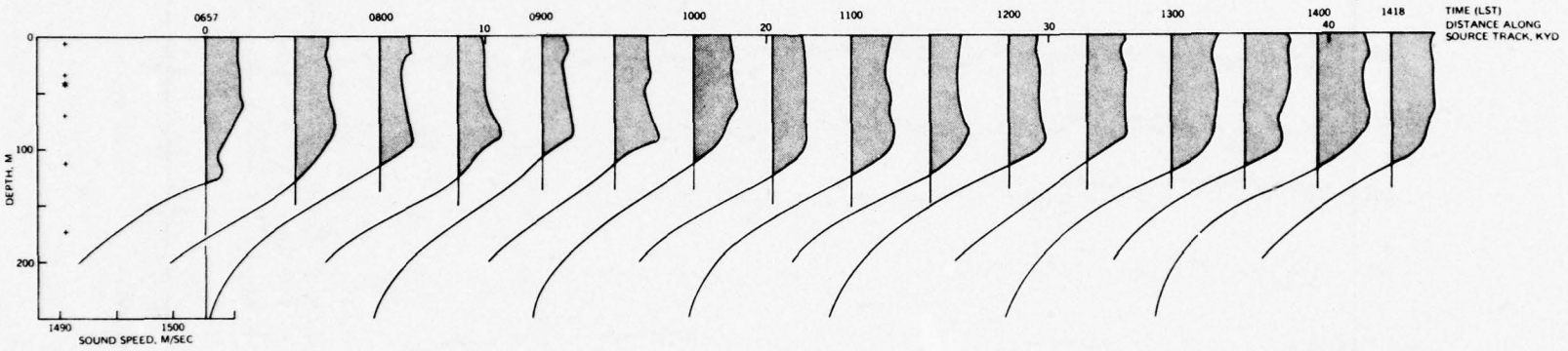


Figure C-3. Station 3, run 3. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depth (+).

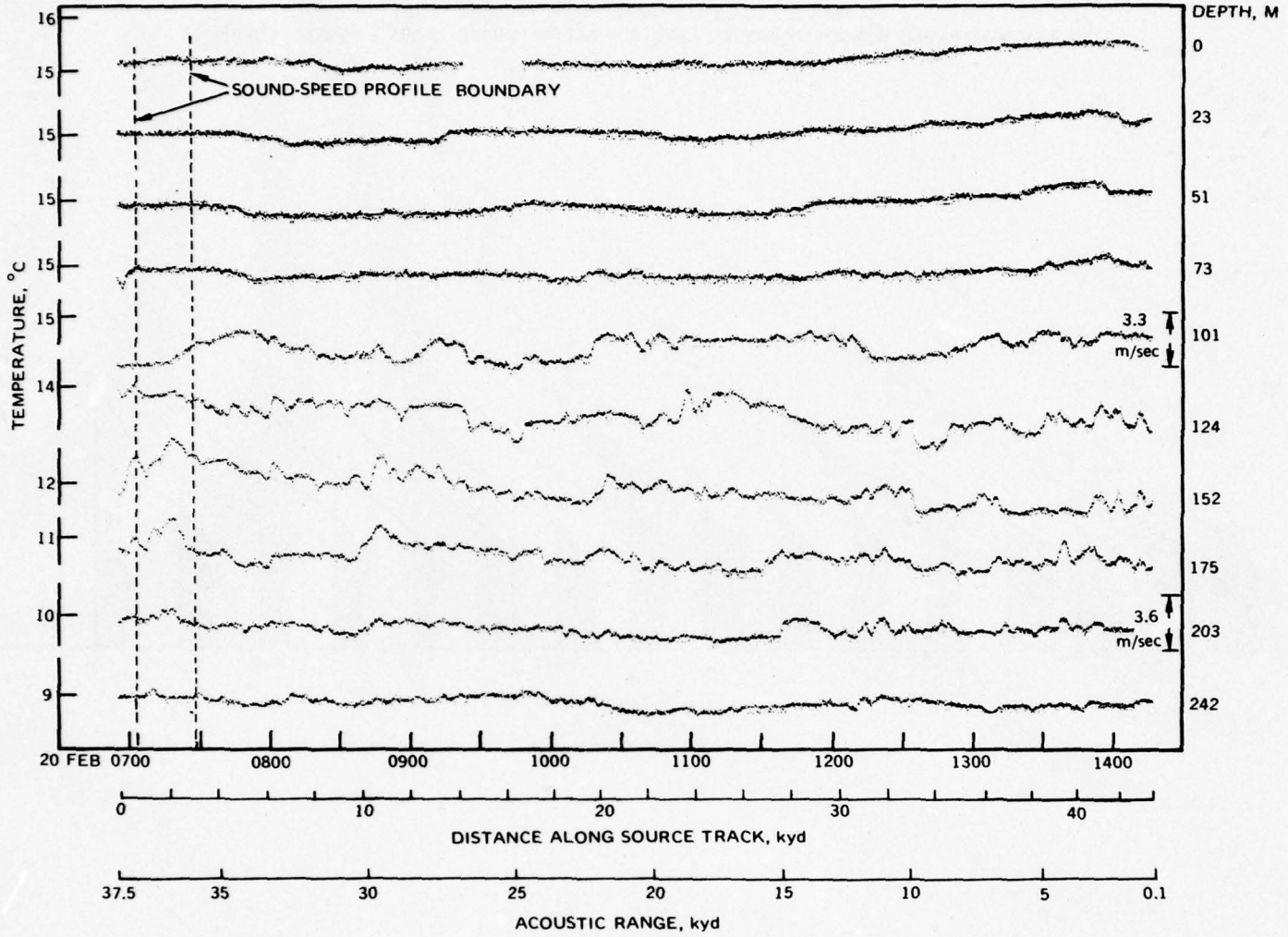


Figure C-4. Station 3, run 3. Thermistor chain temperature measurements selected depths. Dotted lines indicate transition between two sound-speed profile shapes. Time is LST.

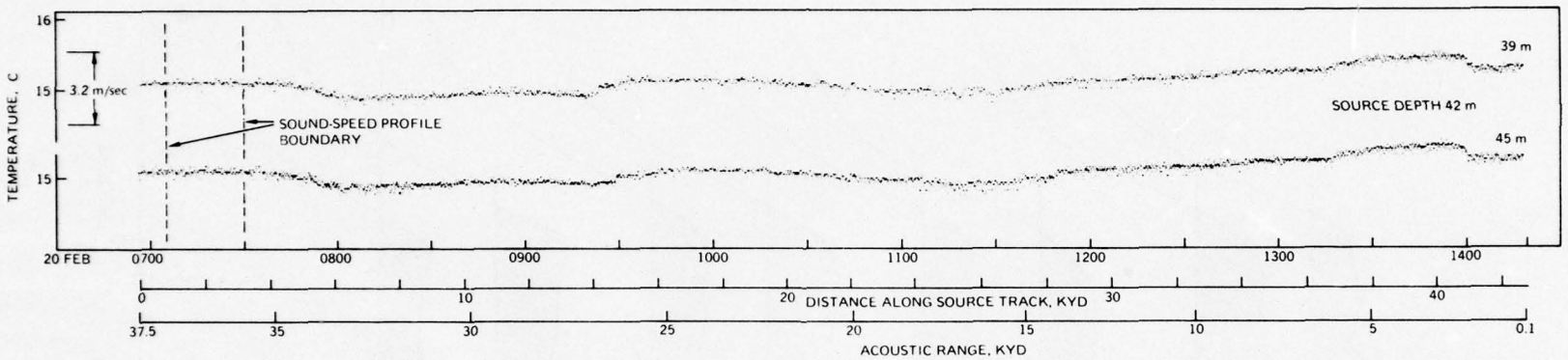


Figure C-5. Station 3, run 3. Temperatures above and below source. Time is LST.

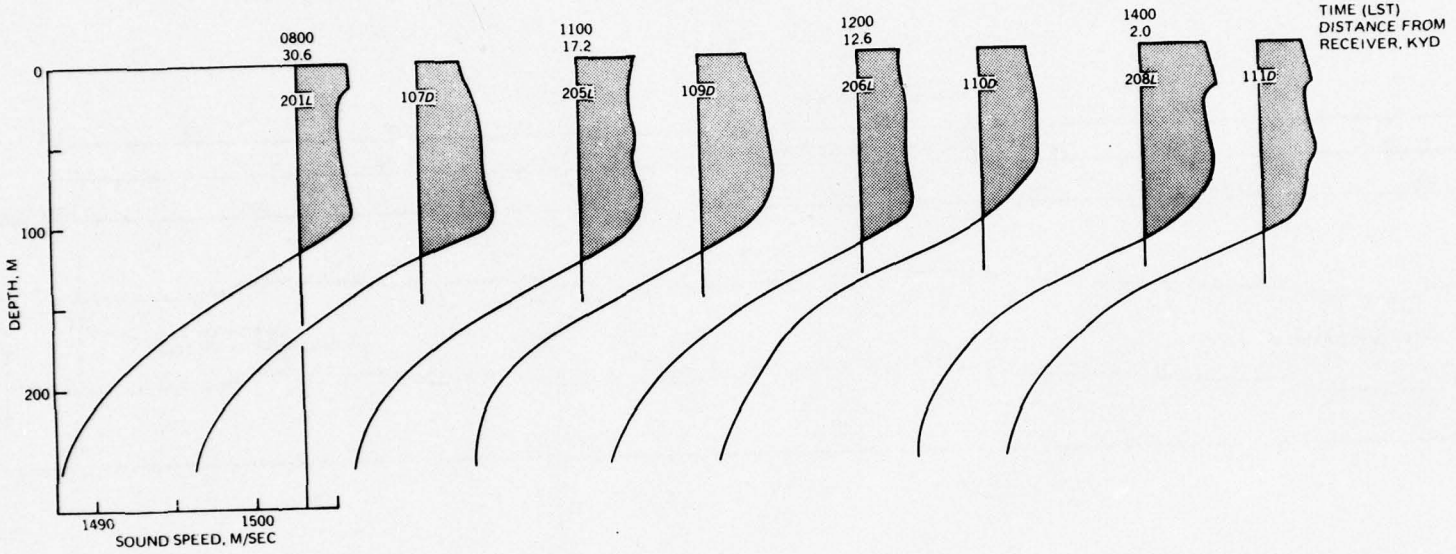


Figure C-6. Station 3, run 3. Spatial change in sound-speed profile.

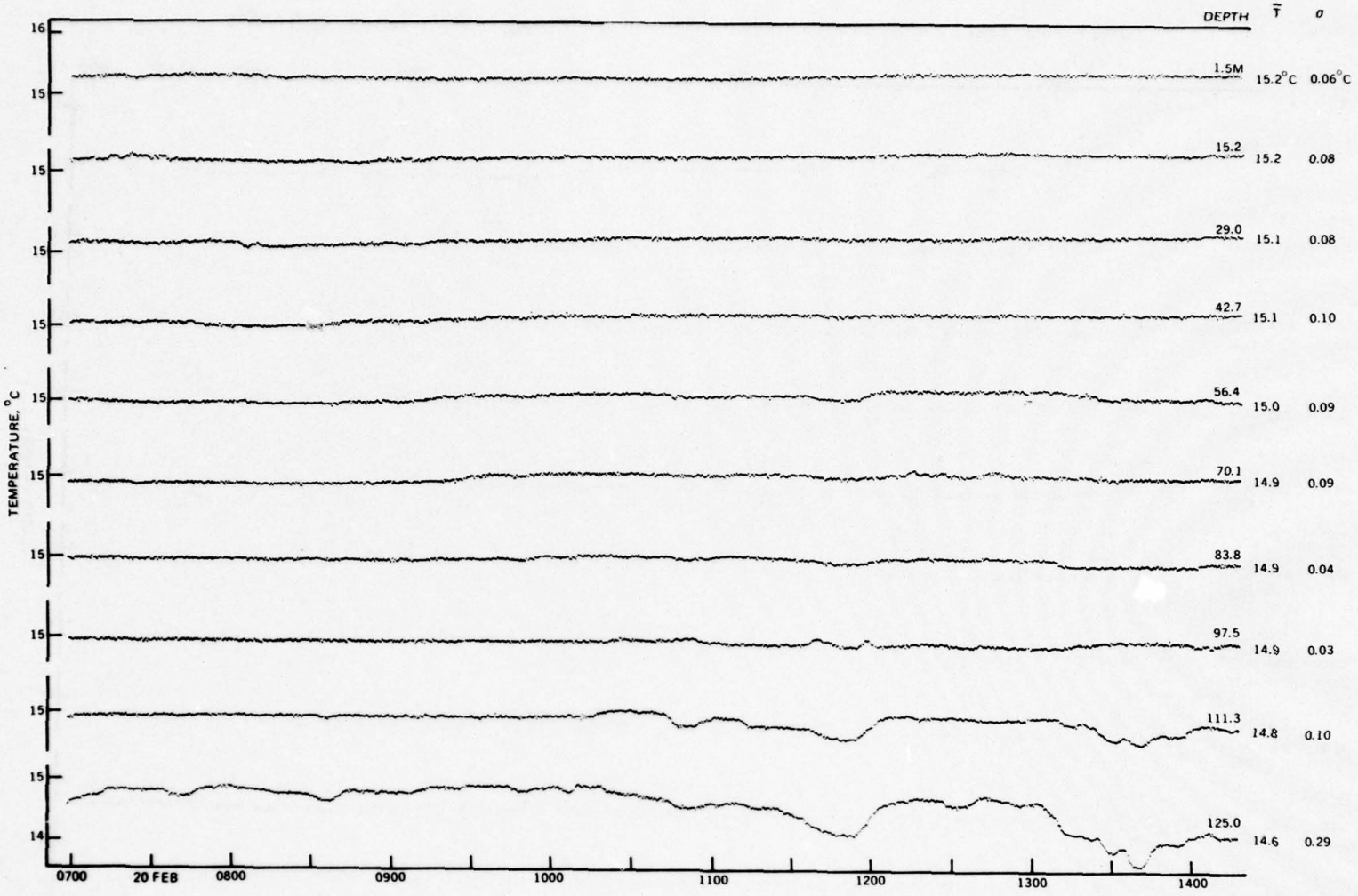


Figure C-7a. Station 3, run 3. Teletherm buoy 5 temperature measurements (n = 2442). Time is LST.

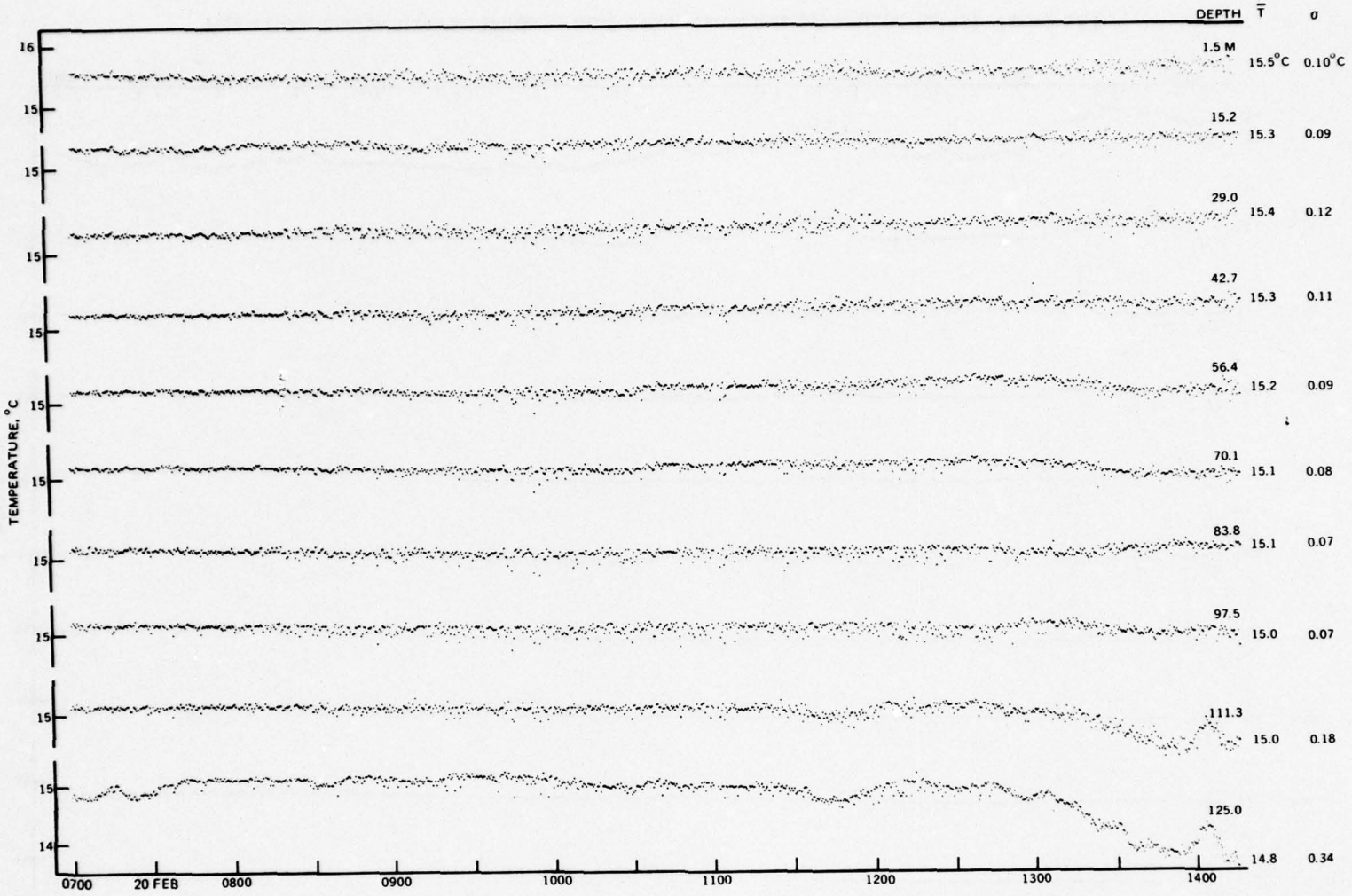


Figure C-7b. Station 3, run 3. Teletherm buoy 6 temperature measurements (n = 2284). Time is LST.

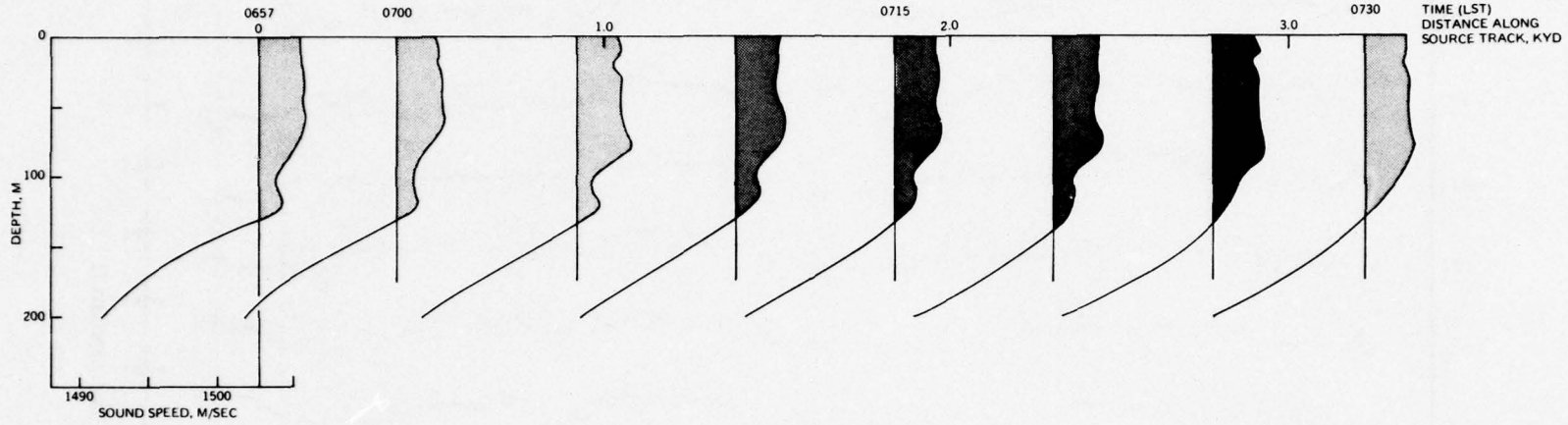


Figure C-11. Station 3, run 3. Expanded sound-speed profile plots.

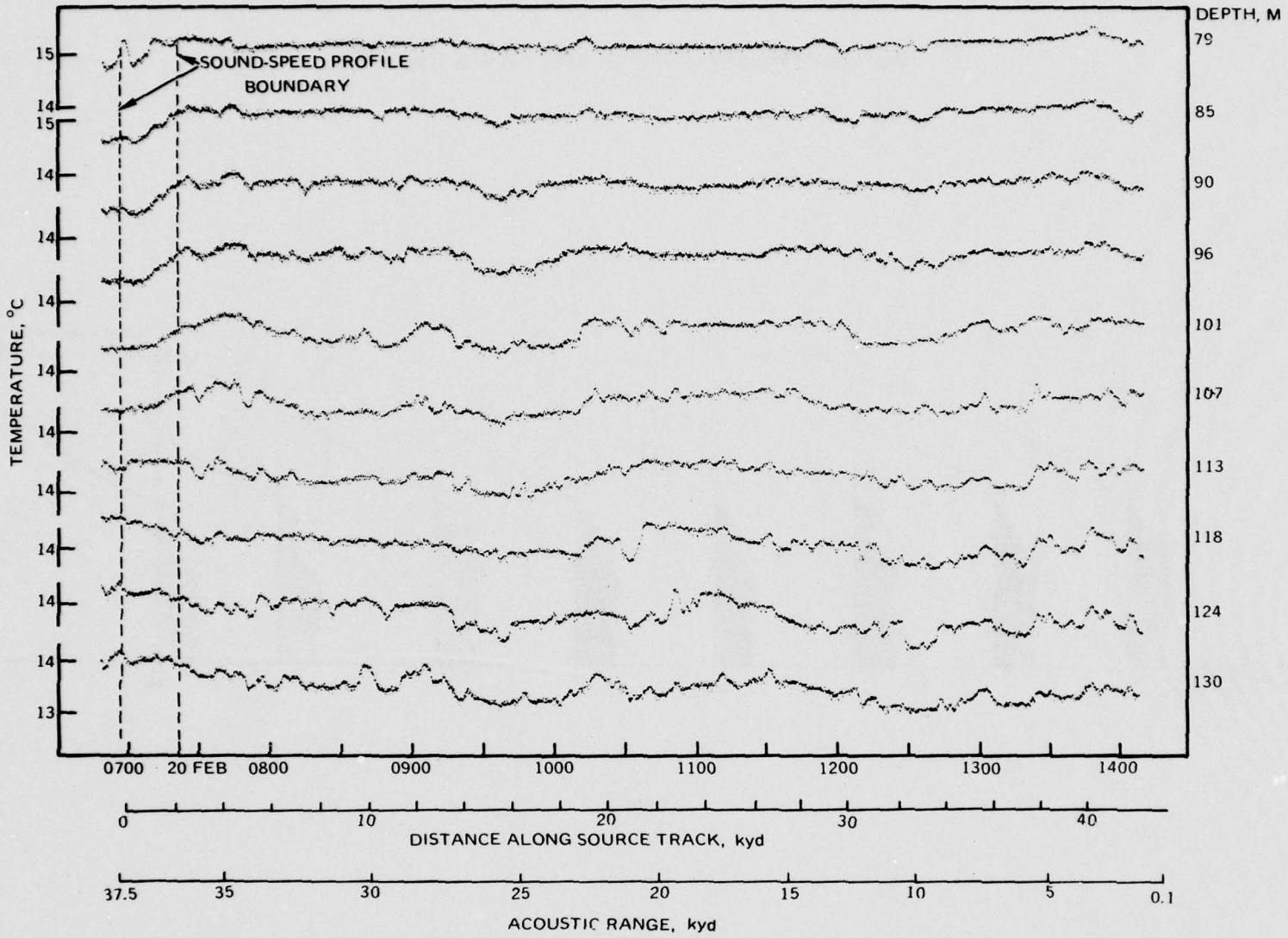


Figure C-12. Station 3, run 3. Thermistor chain temperature measurements at about 6-m depth intervals from 79 to 130 m. Dotted lines indicate transition between two sound-speed profile shapes. Time is LST.

Table C-1. Temperature Profiles (°C),
Station 3 Run 3 (20 February 1972 0658-1418 LST).

XBT MEASUREMENTS

Depth, m	201L 0800	202L 0900	204L 1000	205L 1100	206L 1200	207L 1300	208L 1400
0	15.2	15.1	15.3	15.4	15.1	15.6	15.6
10	15.2	15.1	15.3	15.3	15.0	15.4	15.6
20	15.0	15.0	15.3	15.2	15.0	15.3	15.6
30	14.9	14.9	15.2	15.1	15.0	15.3	15.4
50	14.8	14.9	15.2	15.1	14.9	15.3	15.3
75	14.8	14.9	14.9	15.0	14.8	15.1	15.3
100	14.5	14.2	14.3	14.8	14.6	14.7	14.7
125	13.2	13.2	13.1	13.6	13.1	13.4	13.3
150	11.8	12.1	11.9	12.1	11.6	11.7	11.5
200	9.7	9.9	9.8	9.8	9.5	9.8	9.6
250	8.6	8.8	8.8	8.8	8.4	8.7	8.8
300	7.7	7.8	7.9	7.8	7.5	7.7	7.8
400	6.7	6.6	6.8	6.8	6.4	6.6	6.7
ILD	18	14	20	0	0	0	22
T	*15.2*	*15.1*	*15.3*	*15.4*	*15.1*	*15.6*	*15.6*
SLD	98	90	89	82	95	90	75

Depth, m	107D 0800	109D 1100	110D 1200	111D 1400
0	15.1	15.1	15.2	15.1
10	15.1	15.2	15.2	15.1
20	15.2	15.3	15.2	15.1
30	15.2	15.3	15.2	15.0
50	15.2	15.3	15.1	15.0
75	15.1	15.3	14.9	14.8
100	15.1	14.8	13.9	14.5
125	13.2	13.3	12.5	13.0
150	12.9	11.9	20.7	11.2
200	9.9	9.5	9.1	9.2
250	8.8	8.8	8.2	8.3
300	7.8	8.0	7.5	7.6
400	6.8	6.9	6.4	6.4
ILD	50	75	46	20
T	15.2	15.3	15.2	15.1
SLD	100	95	72	100

Table C-1, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	0657	0700	0705	0710	0715	0720	0725	0730
0	15.2	15.2	15.2	15.3	15.2	15.3	15.2	15.2
10	15.2	15.2	15.2	15.2	15.2	15.2	15.3	15.2
20	15.1	15.1	15.0	15.1	15.1	15.1	15.0	15.1
30	15.1	15.1	15.2	15.0	15.1	15.1	15.1	15.1
50	15.0	15.0	15.1	15.0	15.0	14.9	15.0	15.0
75	14.8	14.7	15.1	14.9	14.9	15.0	15.0	15.0
100	14.2	14.1	14.2	14.2	14.2	14.2	14.4	14.5
125	14.0	13.9	14.0	13.8	13.9	13.9	13.9	13.8
150	12.2	12.4	12.6	12.6	12.8	13.1	13.0	12.7
200	10.0	10.0	10.0	10.0	10.1	10.3	10.1	10.0
ILD	28	11	11	0	11	6	11	11
T	15.2	15.2	15.2	15.3	15.2	15.3	15.2	15.2
SLD	118	118	118	113	113	79	90	79

Depth, m	0830	0930	1030	1130	1230	1330	1418
0	15.0	15.2	15.1	15.2	15.3	15.5	15.5
10	15.0	14.2	15.1	15.1	15.2	15.4	15.4
20	14.9	14.2	15.1	15.0	15.1	15.4	15.3
30	14.9	15.1	15.1	15.0	15.2	15.4	15.3
50	14.8	14.9	15.0	14.8	15.0	15.2	15.2
75	14.9	15.0	14.8	14.9	14.9	14.9	15.0
100	14.4	14.3	14.7	14.6	14.3	14.7	14.6
125	13.7	13.2	13.6	13.7	13.1	13.2	13.2
150	12.3	12.1	12.1	11.9	11.9	11.6	11.8
200	9.8	9.9	9.8	9.7	9.8	9.9	9.9
ILD	45	39	28	6	6	6	0
T	15.0	15.1	15.1	15.2	15.3	15.5	15.5
SLD	90	96	100	85	90	101	101

Table C-2. Computed Sound-Speed Profiles (m/sec), Station 3 Run 3 (20 February 1972 0658-1418 LST).

XBT MEASUREMENTS

Depth, m	201L 0800	202L 0900	204L 1000	205L 1100	206L 1200	207L 1300	208L 1400
0	1506.0	1505.6	1506.3	1506.6	1505.6	1507.2	1507.2
10	06.1	05.8	06.4	06.4	05.5	06.8	07.4
20	05.6	05.6	06.6	06.3	05.6	06.4	07.6
30	05.5	05.5	06.5	06.1	05.8	06.8	07.1
50	05.5	05.8	06.8	06.5	05.8	07.1	07.1
75	05.9	06.2	06.2	06.6	05.9	06.9	07.6
100	05.5	04.4	04.8	06.5	05.8	06.1	06.1
125	01.6	01.6	01.3	03.0	01.3	02.3	01.9
150	1497.2	1498.3	1497.6	1498.3	1496.5	1496.9	1496.2
200	90.8	91.6	91.2	91.2	90.1	91.2	90.5
250	87.8	88.6	88.6	88.6	87.1	88.2	88.6
300	85.4	85.8	86.2	85.8	84.6	85.4	85.8
400	83.3	82.9	83.7	83.7	82.0	82.9	83.3
SC	18	14	20	0	0	0	22
DC	40	30	30	30	10	20	40
MAX	98	90	65	82	95	50	75

Depth, m	107D 0800	109D 1100	110D 1200	111D 1400
0	1505.6	1506.0	1506.0	1505.6
10	05.8	06.1	06.1	05.8
20	06.3	06.6	06.3	06.0
30	06.5	06.8	06.5	05.8
50	06.8	07.1	06.5	06.2
75	06.9	07.6	06.2	05.9
100	07.5	06.5	03.4	05.5
125	01.6	01.9	1499.2	00.9
150	1497.9	1497.6	93.4	1495.1
200	91.6	90.1	88.7	89.1
250	88.6	88.6	86.3	86.7
300	85.8	86.5	84.6	85.0
400	83.7	84.1	82.0	82.0
SC	100	75	50	20
DC				30
MAX				70

Table C-2, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	0657	0700	0705	0710	0715	0720	0725	0730
0	1506.0	1505.8	1506.0	1506.3	1505.9	1506.3	1505.9	1506.0
10	06.0	06.0	06.2	06.1	06.0	06.2	06.3	06.0
20	06.0	05.9	05.7	06.1	06.1	06.0	05.8	05.8
30	06.2	06.2	06.3	05.8	06.2	06.2	06.2	06.2
50	06.2	06.2	06.3	06.3	06.0	05.9	06.2	06.1
75	06.8	05.5	06.8	06.3	06.2	06.5	06.6	06.6
100	04.4	04.2	04.4	04.4	04.3	04.4	05.1	05.5
125	04.2	04.0	04.3	03.7	03.9	04.1	03.9	03.5
150	1498.5	1499.2	00.2	1499.9	00.7	01.9	01.3	00.4
200	91.7	92.0	1491.9	91.7	1492.2	1492.9	1492.2	1491.9
SC	56	11	11	0	30	6	11	11
DC		20	20	34	50	20	20	20
MAX		62	79	62	62	30	75	30
DC	107	101	110	101	107	50		50
MAX	118	118	118	113	113	79		79

Depth, m	0830	0930	1030	1130	1230	1330	1418
0	1505.2	1505.9	1505.7	1505.9	1506.3	1506.8	1506.8
10	05.4	06.0	05.9	05.8	06.1	06.9	06.6
20	05.4	06.1	06.0	05.7	06.1	06.9	06.7
30	05.5	06.2	06.0	05.7	06.4	07.0	06.7
50	05.4	05.8	06.0	05.5	06.3	06.9	06.7
75	06.4	06.5	06.0	06.1	06.3	06.1	06.5
100	05.1	04.8	06.0	05.8	04.7	06.3	05.7
125	03.3	01.6	02.9	03.1	01.3	01.5	01.4
150	1498.8	1498.2	1498.4	1497.7	1497.7	1496.4	1497.7
200	91.2	91.7	91.2	90.8	91.3	91.4	91.5
SC	30	39	28	6	6	6	0
DC	50	50		50	15	15	10
MAX	90	96		85	90	30	68
						75	
						101	

Table C-3. Average Sound-Speed Profile (m/sec), Station 3 Run 3 (20 February 1972 0658-1418 LST).

Depth,	Profile 1 0658-0706			Profile 2 0706-0731			Profile 3 0731-1418		
m	n	$\overline{C}$	σ	n	$\overline{C}$	σ	n	$\overline{C}$	σ
0	54	1505.96	0.01	144	1506.12	0.16	2248	1506.06	0.46
10	54	06.05	0.16	144	06.05	0.13	2248	06.12	0.45
20	54	05.99	0.20	144	05.99	0.10	2248	06.06	0.49
30	54	06.11	0.10	144	06.11	0.10	2248	06.07	0.49
50	54	06.38	0.13	144	06.42	0.13	2248	06.12	0.56
75	54	05.91	0.53	144	06.54	0.17	2248	06.24	0.30
100	54	04.25	0.14	144	04.72	0.43	2248	05.53	0.64
125	54	04.16	0.27	144	03.89	0.21	2248	02.38	0.76
150	54	1499.57	0.91	144	00.93	0.70	2248	1498.14	0.94
200	54	91.95	0.14	144	1492.31	0.43	2248	91.45	0.47
250	54	89.16	0.16	144	89.16	0.23	2248	88.79	0.38
300	15	85.62	0.59						
400	15	83.02	0.63						
500	9	81.81	0.29						
600	5	81.36	0.36						
800	4	81.25	0.15						
1000	4	82.17	0.22						
1200	4	83.47	0.22						
1500	4	86.06	0.22						
11		1506.08			1506.08			1506.14	SC
17					1505.95				DC
20		1505.99						1506.06	DC
62		1506.62							MAX
75					1506.54				MAX
79								1506.30	MAX
101					1504.65				DC
105		1503.75							DC
113					1504.75				MAX
118		1504.55							MAX
700		1481.20			1481.20			1481.20	AXIS

Table C-4. Average Thermistor Chain Temperatures, Station 3 Run 3, **Profile 1** (number of measurements at each depth: 54).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.12	15.27	15.20	0.032
6	15.07	15.27	15.19	0.039
11	15.05	15.25	15.17	0.044
17	15.02	15.20	15.10	0.035
23	15.05	15.15	15.11	0.026
28	15.02	15.17	15.10	0.030
34	14.97	15.12	15.07	0.031
39	14.97	15.20	15.09	0.036
45	14.97	15.17	15.07	0.038
51	14.98	15.10	14.98	0.039
56	14.97	15.12	15.07	0.035
62	14.97	15.15	15.06	0.033
68	14.62	15.02	14.86	0.089
73	14.62	15.10	14.88	0.126
79	14.35	14.97	14.57	0.157
85	14.25	14.42	14.34	0.043
90	14.12	14.37	14.26	0.051
98	14.10	14.25	14.17	0.034
101	14.02	14.20	14.14	0.037
107	14.02	14.22	14.12	0.036
113	14.07	14.35	14.20	0.065
118	14.20	14.35	14.28	0.034
124	13.77	14.15	13.99	0.079
130	13.52	13.92	13.73	0.113
135	12.82	13.70	13.27	0.325
141	12.82	13.47	13.00	0.288
147	12.42	12.85	12.66	0.134
152	11.82	12.60	12.26	0.272
158	11.55	12.20	11.90	0.224
164	11.57	11.75	11.65	0.047
169	10.97	11.67	11.46	0.192
175	10.77	11.10	10.93	0.108
180	10.67	10.85	10.78	0.034
186	10.42	10.62	10.52	0.035
192	10.25	10.47	10.33	0.056
197	9.90	10.07	10.00	0.030
203	9.87	10.10	10.01	0.050
209	9.77	9.95	9.87	0.037
214	9.67	9.87	9.79	0.038
220	9.45	9.67	9.59	0.052
226	9.27	9.60	9.46	0.091
231	9.17	9.40	9.31	0.034
237	9.07	9.35	9.26	0.060
242	8.97	9.15	9.07	0.037

Table C-4, continued. **Profile 2** (number of measurements at each depth: 144).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.12	15.35	15.25	0.047
6	15.12	15.37	15.25	0.048
11	15.05	15.25	15.16	0.043
17	15.02	15.20	15.11	0.035
23	14.97	15.20	15.11	0.033
28	14.97	15.20	15.10	0.030
34	14.97	15.15	15.06	0.041
39	14.97	15.20	15.09	0.039
45	14.95	15.17	15.08	0.041
51	14.87	15.10	15.80	0.038
56	14.97	15.17	15.07	0.040
62	14.97	15.15	15.07	0.041
68	14.75	15.02	14.88	0.054
73	14.92	15.10	15.01	0.035
79	14.47	15.05	14.81	0.170
85	14.25	14.90	14.56	0.190
90	14.12	14.82	14.43	0.209
98	14.07	14.75	14.36	0.198
101	14.02	14.57	14.27	0.132
107	14.05	14.50	14.26	0.121
113	*14.20*	*14.40*	*14.30*	*0.034*
118	13.85	14.30	14.10	0.098
124	13.72	14.05	13.89	0.064
130	13.52	13.82	13.88	0.059
135	13.27	13.70	13.50	0.084
141	12.97	13.57	13.33	0.145
147	12.65	13.50	13.08	0.238
152	12.20	13.02	12.63	0.191
158	11.77	12.50	12.19	0.190
164	11.57	12.17	11.87	0.160
169	11.37	11.85	11.62	0.117
175	10.75	11.50	11.14	0.214
180	10.57	11.00	10.75	0.089
186	10.35	10.72	10.54	0.081
192	10.25	10.52	10.41	0.062
197	9.92	10.40	10.18	0.125
203	9.82	10.27	10.03	0.098
209	9.77	10.02	9.89	0.056
214	9.67	9.90	9.79	0.038
220	9.55	9.82	9.69	0.061
226	9.35	9.70	9.53	0.088
231	9.07	9.45	9.29	0.071
237	9.02	9.40	9.25	0.086
242	8.97	9.30	9.09	0.060

Table C-4, continued. **Profile 3** (number of measurements at each depth: 2448).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0*	-	15.60	15.23	0.273
6	14.95	15.57	15.23	0.140
11	14.92	15.55	15.19	0.142
17	14.85	15.52	15.14	0.152
23	14.77	15.50	15.11	0.149
28	14.77	15.52	15.10	0.151
34	14.72	15.45	15.05	0.152
39	14.72	15.50	15.06	0.155
45	14.72	15.47	15.03	0.157
51	14.65	15.40	14.95	0.165
56	14.72	15.42	15.00	0.153
62	14.70	15.42	14.98	0.147
68	14.57	15.35	14.89	0.145
73	14.67	15.30	14.90	0.097
79	14.62	15.25	14.90	0.085
85	14.55	15.10	14.84	0.090
90	14.37	15.02	14.76	0.097
96	14.25	14.92	14.67	0.126
101	13.95	14.82	14.48	0.186
107	13.75	14.72	14.26	0.176
113	13.55	14.40	14.04	0.171
118	13.27	14.25	13.78	0.186
124	12.77	14.00	13.48	0.234
130	12.67	13.65	13.15	0.203
135	12.25	13.42	12.84	0.210
141	11.72	13.37	12.62	0.254
147	11.52	13.00	12.30	0.285
152	11.32	12.62	11.92	0.271
158	11.10	12.25	11.86	0.234
164	10.77	11.90	11.31	0.248
169	10.47	11.55	10.98	0.190
175	10.27	11.32	10.70	0.174
180	10.15	11.12	10.50	0.165
186	9.75	10.97	10.28	0.152
192	9.62	10.57	10.12	0.162
197	9.52	10.37	9.94	0.152
203	9.45	10.05	9.79	0.110
209	9.35	9.95	9.62	0.114
214	9.20	9.80	9.49	0.083
220	9.07	9.65	9.39	0.085
226	8.97	9.50	9.28	0.082
231	8.72	9.40	9.13	0.110
237	8.67	9.32	9.04	0.123
242	8.65	9.20	8.94	0.103

*2297 measurements at this depth.

APPENDIX D

STATION 3 RUN 4

DETAILED ENVIRONMENTAL DATA SUMMARY

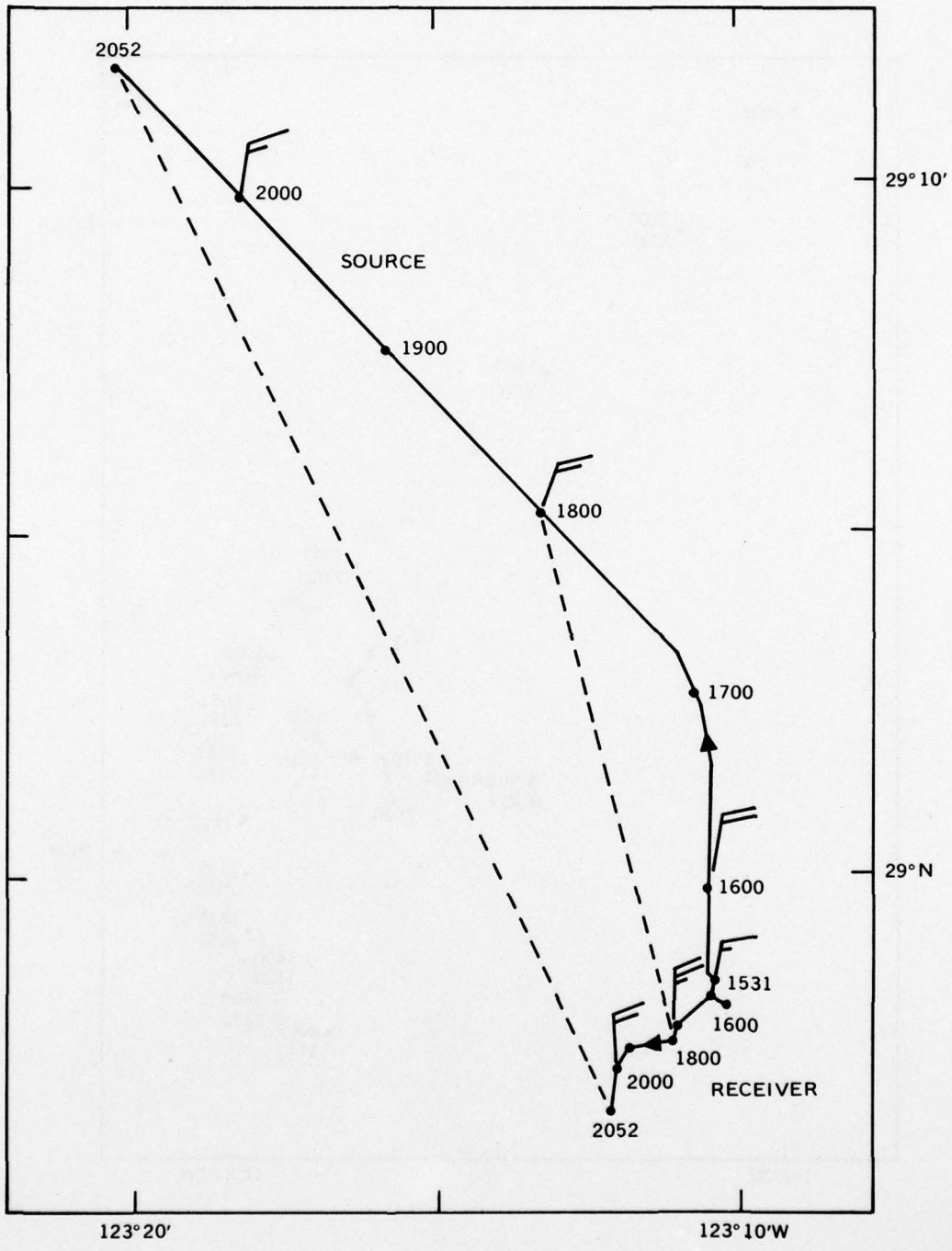


Figure D-1. Station 3, run 4. Location of source and receiver ships, 1800 and 2052 LST propagation paths (---), and wind velocity (•—\\ 10-knot east wind, 1 bar = 5 knots).

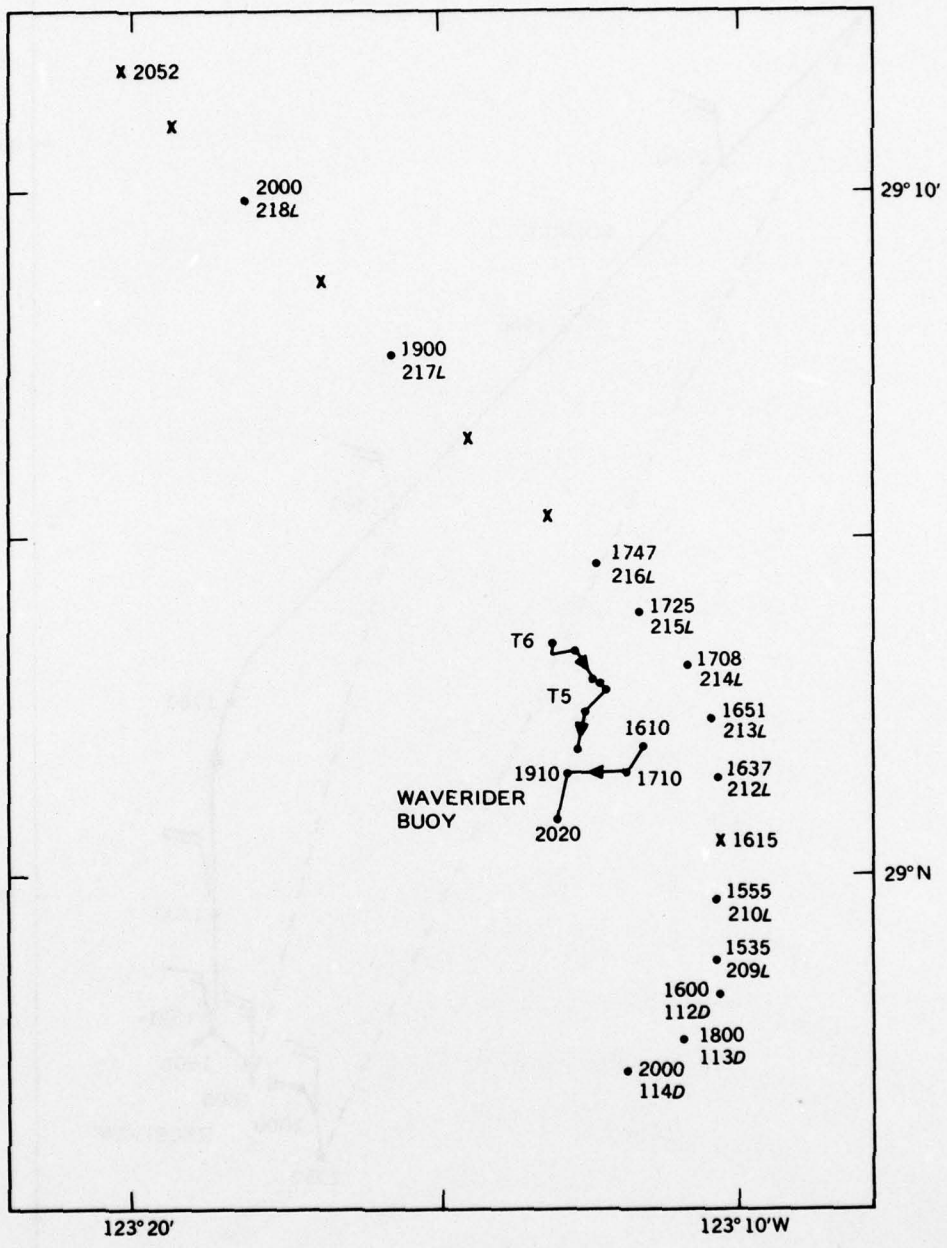


Figure D-2. Station 3, run 4. Location of XBT (·), thermistor chain (X), Teletherm buoy (T), and Waverider buoy measurements. The letter following the XBT number denotes the ship which took the measurement (*L: Lee, D: DeSteiguer*). Times shown are LST.

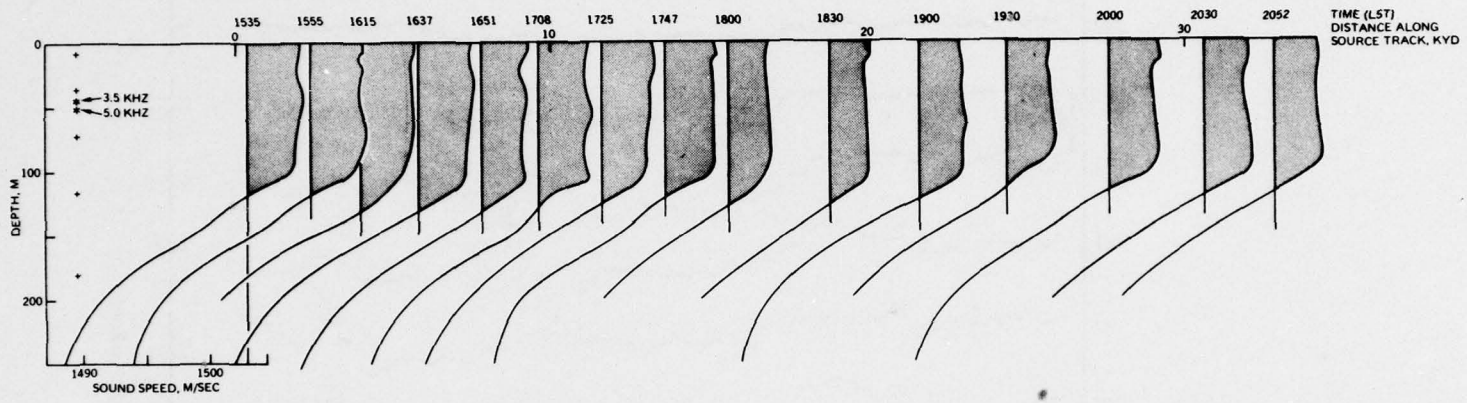


Figure D-3. Station 3, run 4. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depths (*), receiver depths (+).

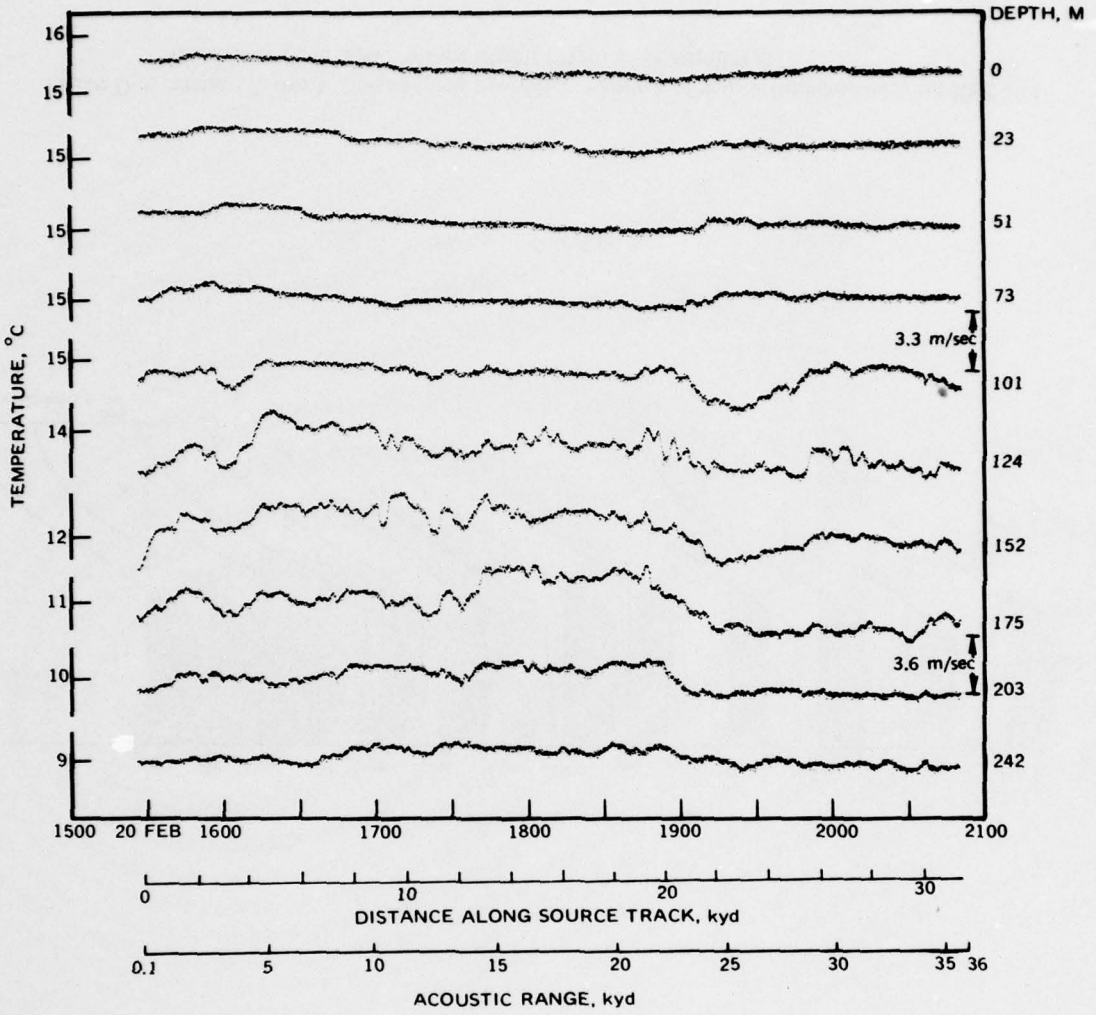


Figure D-4. Station 3, run 4. Thermistor chain temperature measurements at selected depths. Time is LST.

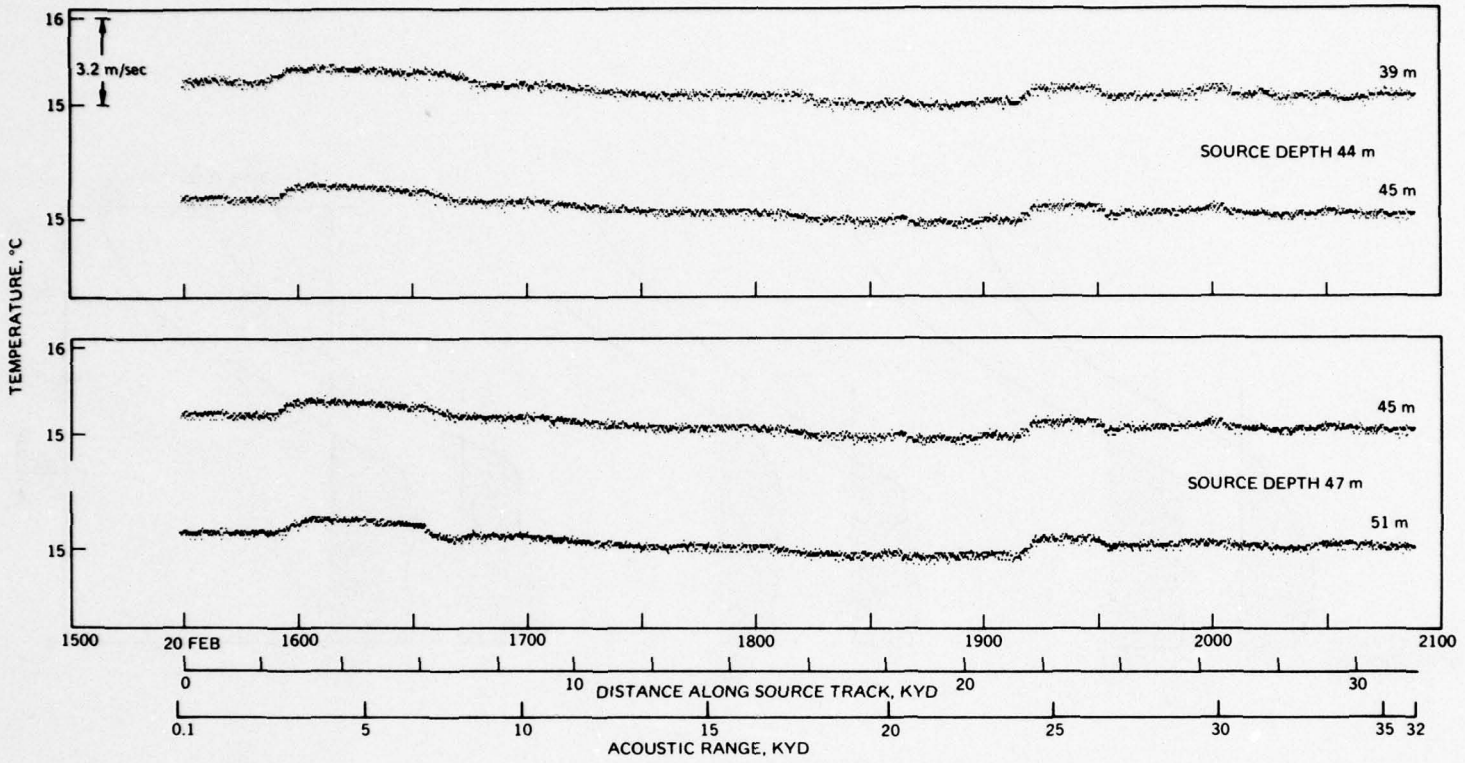


Figure D-5. Station 3, run 4. Temperatures above and below source. Time is LST.

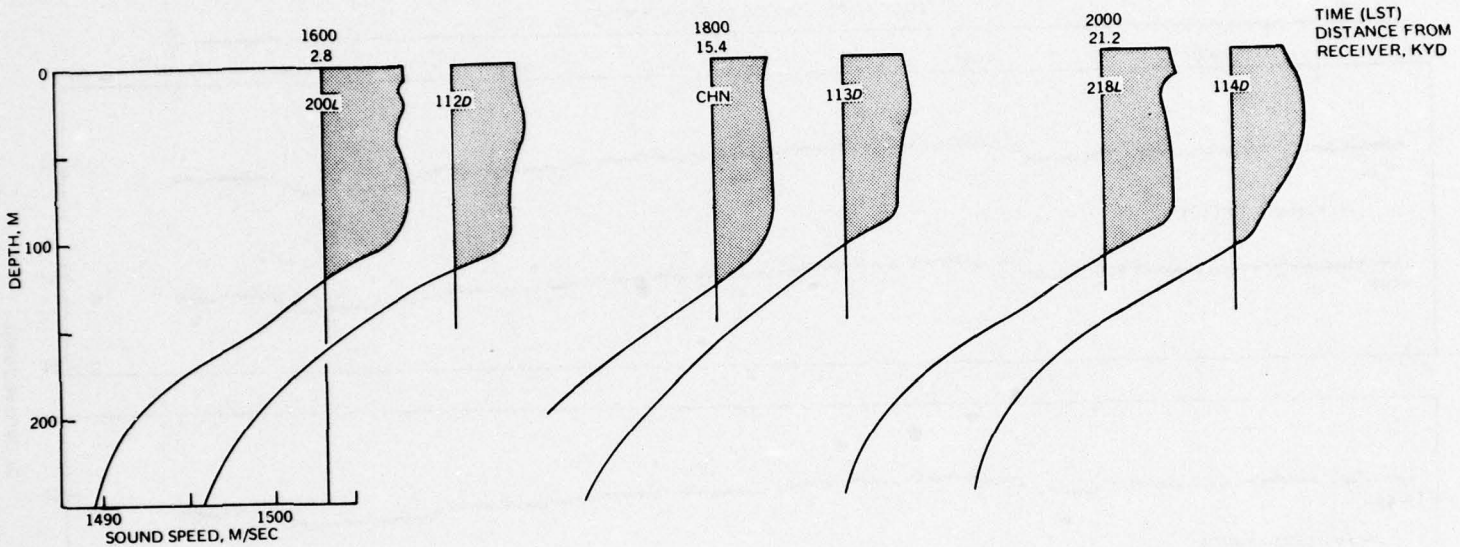


Figure D-6. Station 3, run 4. Spatial change in sound-speed profile.

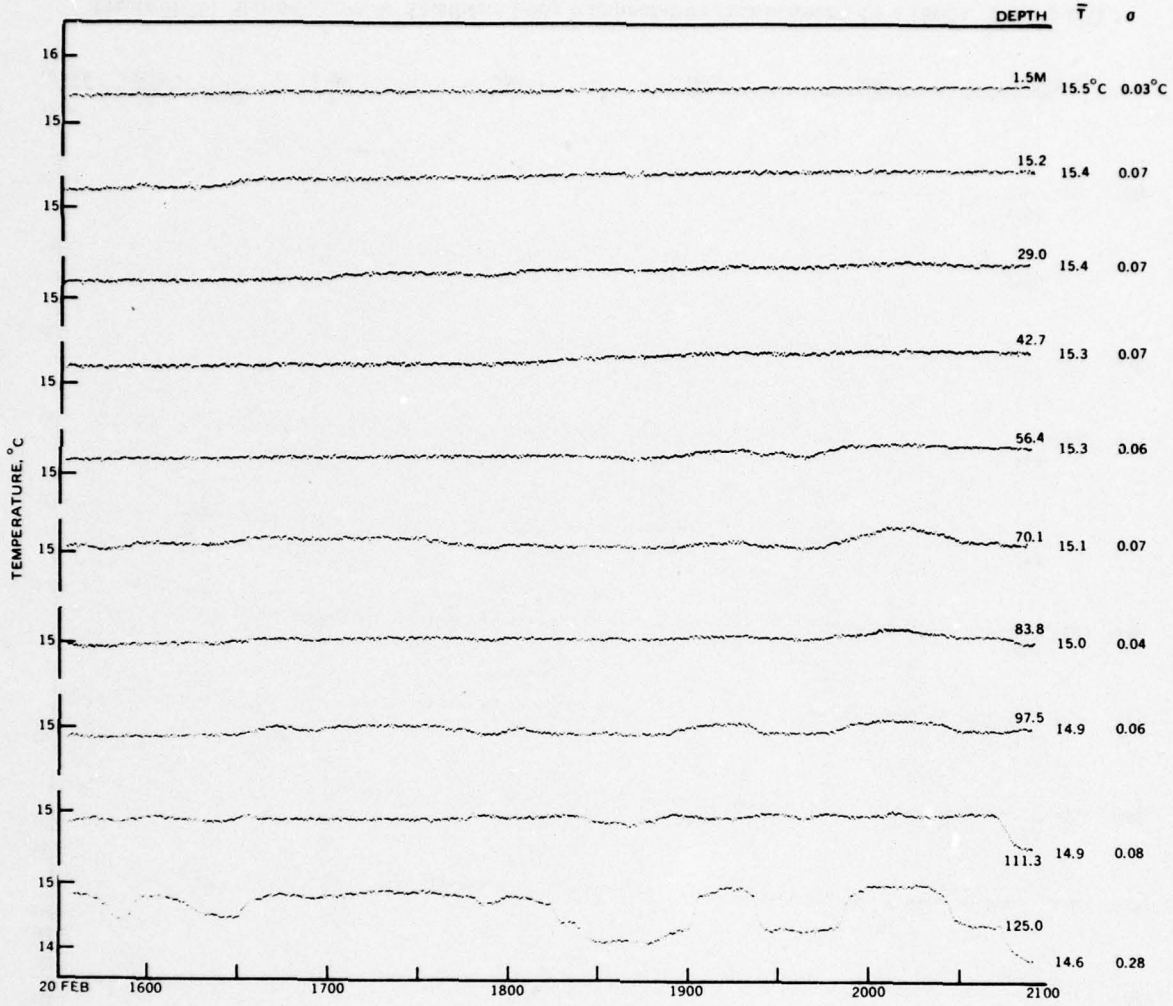


Figure D-7a. Station 3, run 4. Teletherm buoy 5 temperature measurements (n = 1702). Time is LST.

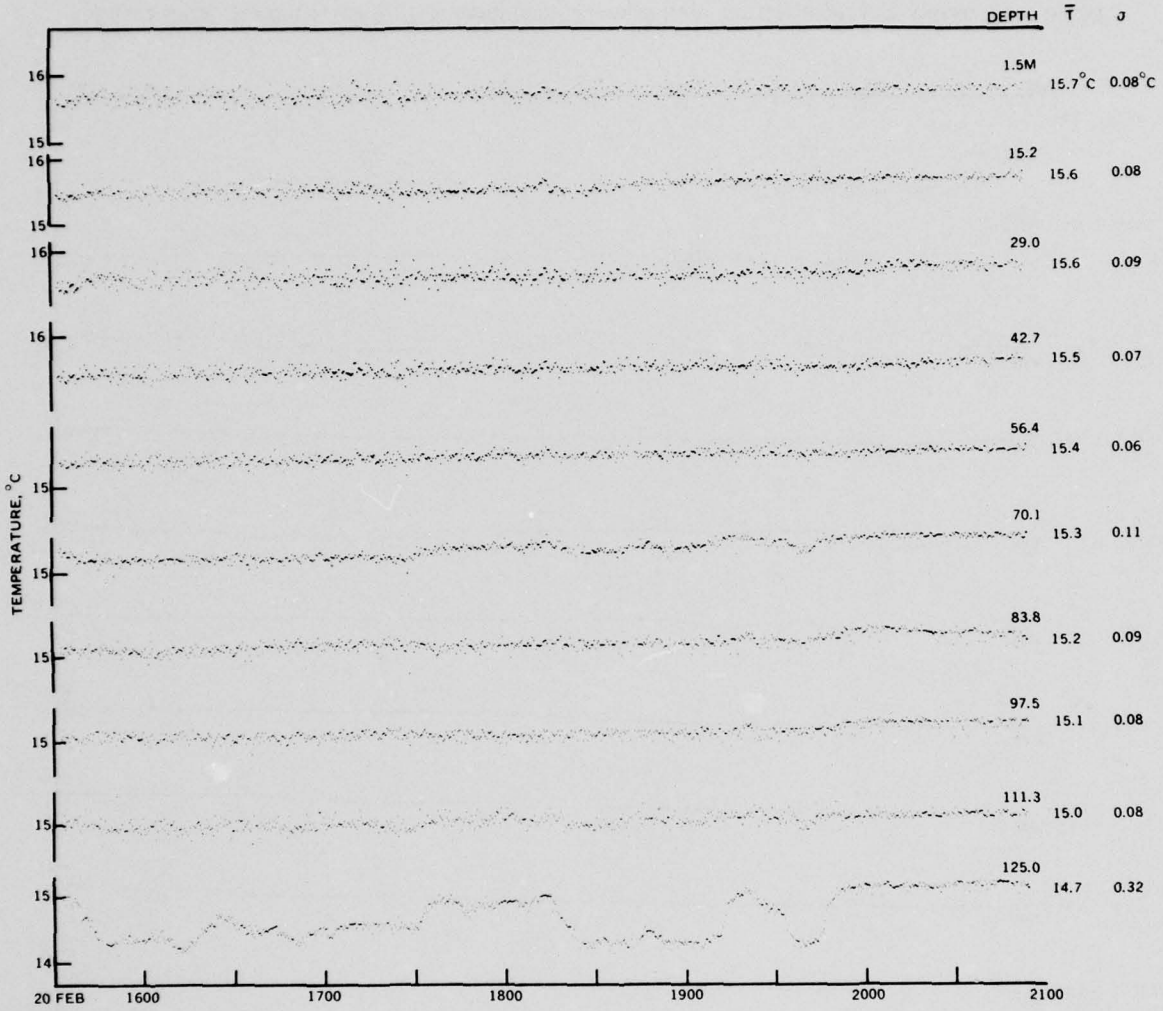


Figure D-7b. Station 3, run 4. Teletherm buoy 6 temperature measurements (n = 1865). Time is LST.

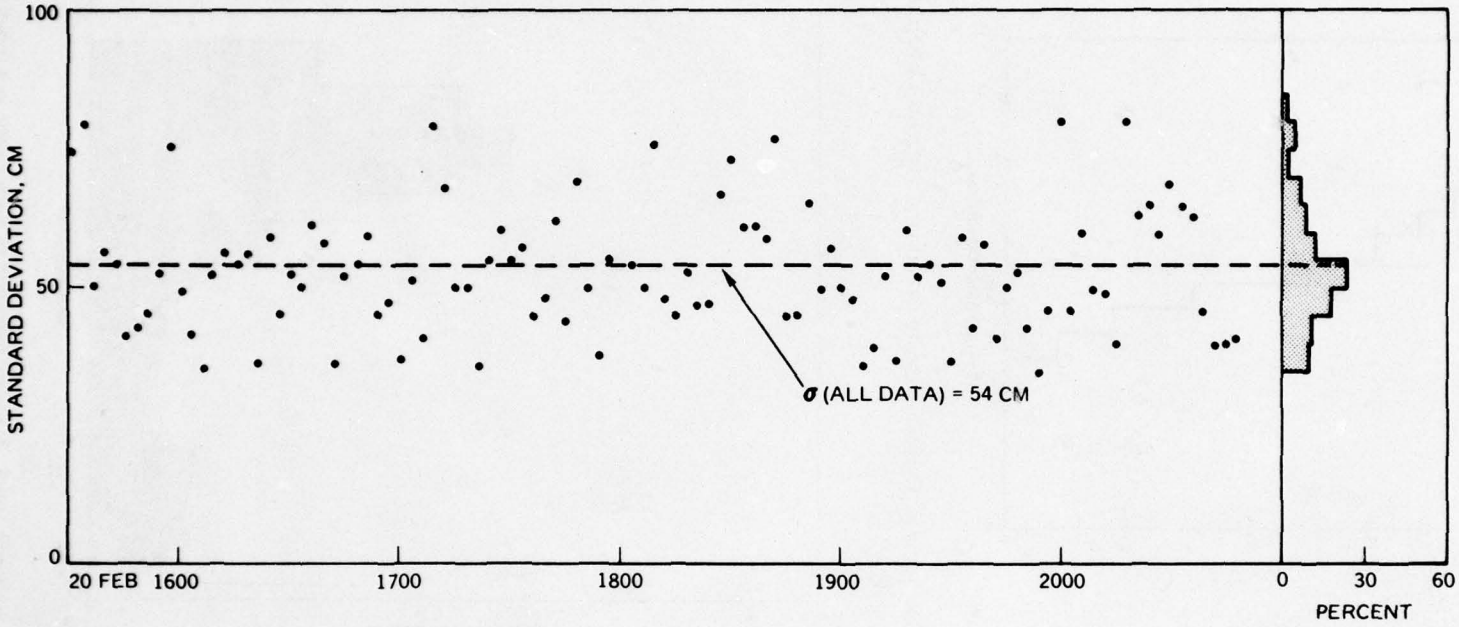


Figure D-8. Station 3, run 4. Standard deviation of surface-wave height for 3-min averages. Time is LST.

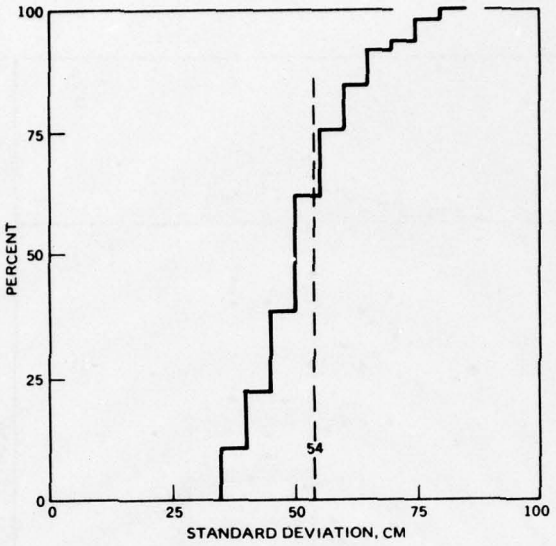


Figure D-9. Station 3, run 4. Ogive of standard deviation of surface-wave height for 3-min averages.

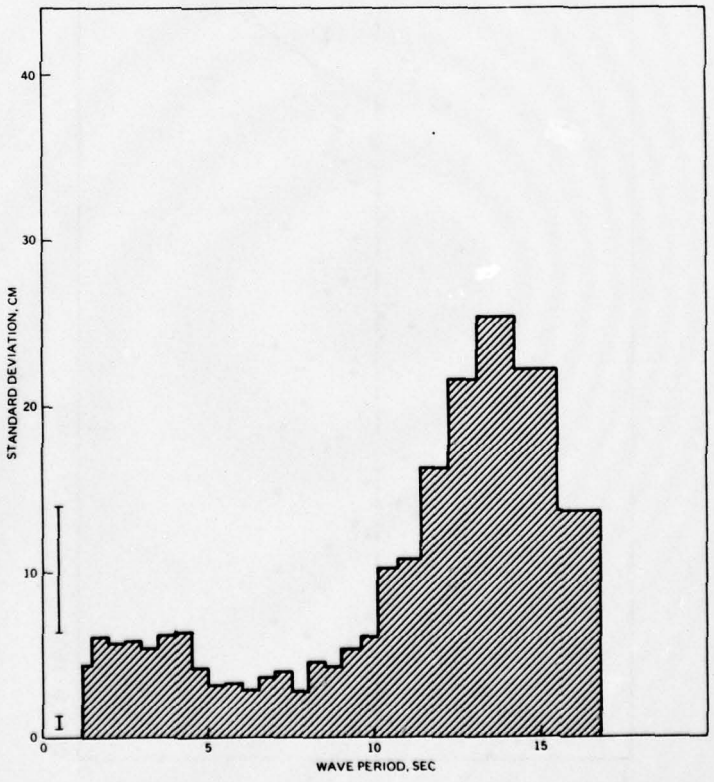


Figure D-10. Station 3, run 4. Standard deivation of wave height as a function of wave period (20 February 1972, 1531-1800 LST).

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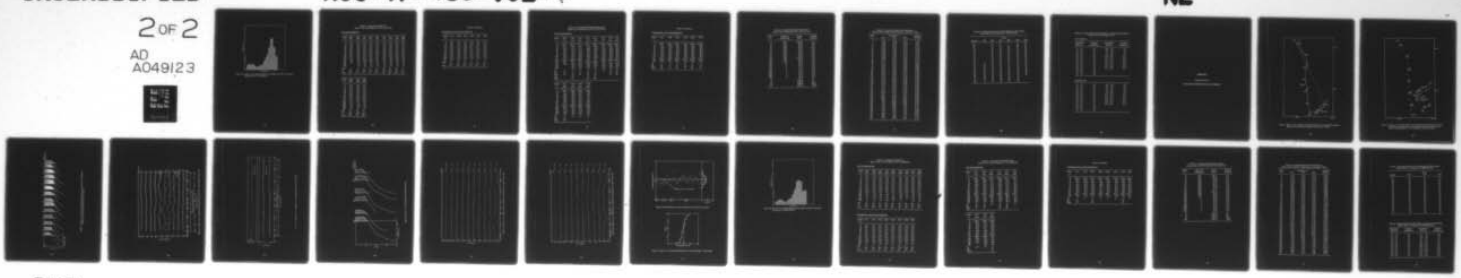

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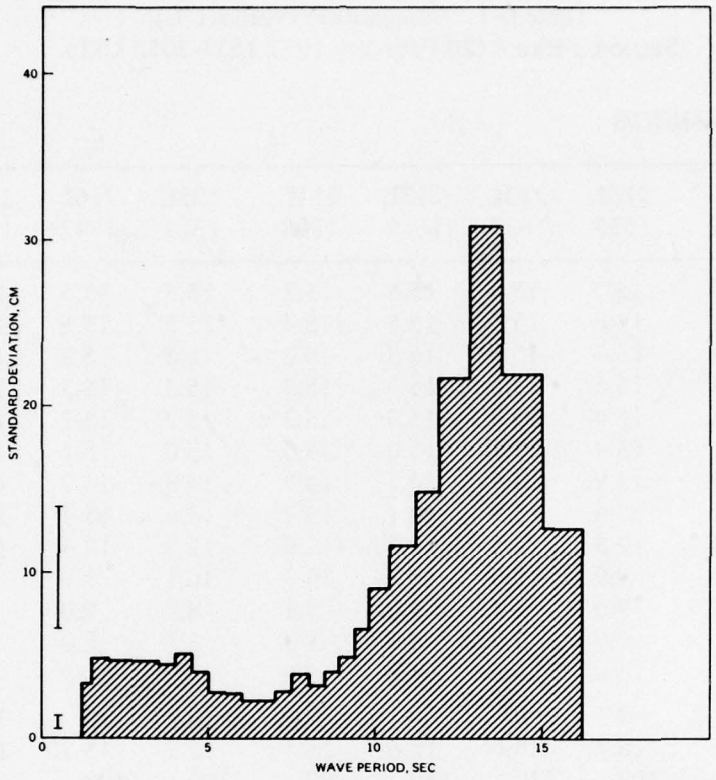

Figure D-11. Station 3, run 4. Standard deviation of wave height as a function of wave period (20 February 1972, 1531-1800 LST).

Table D-1. Temperature Profiles (°C),
Station 3 Run 4 (20 February 1972 1531-2052 LST).

XBT MEASUREMENTS

Depth, m	209L 1535	210L 1555	212L 1637	213L 1651	214L 1708	125L 1725	216L 1747	217L 1900	218L 2000
0	15.6	15.7	15.6	15.6	15.5	15.5	15.5	15.3	15.5
10	15.5	15.6	15.5	15.5	15.4	15.5	15.5	15.3	15.5
20	15.4	15.6	15.5	15.3	15.3	15.5	15.3	15.3	15.3
30	15.4	15.5	15.5	15.3	15.3	15.3	15.3	15.2	15.2
50	15.4	15.4	15.3	15.3	15.3	15.2	15.2	15.1	15.2
75	15.1	15.4	15.1	15.0	15.0	15.0	15.1	15.0	15.1
100	14.8	14.9	14.9	14.9	14.9	14.8	14.9	14.8	14.8
125	13.3	13.4	13.9	14.1	13.7	13.6	13.4	13.5	13.2
150	12.2	12.3	12.5	12.8	12.9	12.3	12.4	12.0	12.0
200	9.8	9.9	10.0	10.3	10.3	10.1	9.9	9.8	9.6
250	8.8	9.0	8.8	9.0	9.1	8.9	9.0	8.9	8.6
300		7.9	7.9	8.1	8.3	8.1	8.0	7.8	7.5
400		6.6	6.8	6.8	6.9	6.7	6.7	6.8	6.6
ILD	0	9	0	0	0	20	10	20	15
T	15.6	15.7	15.6	15.6	15.5	15.5	15.5	15.3	15.5
SLD	100	103	110	110	109	100	100	100	90

Depth, m	112D 1600	113D 1800	114D 2000
0	15.4	15.4	15.2
10	15.4	15.4	15.3
20	15.4	15.4	15.4
30	15.4	15.4	15.4
50	15.2	15.1	15.3
75	14.9	14.9	14.9
100	14.7	14.1	14.2
125	13.0	12.9	13.0
150	11.7	11.7	11.6
200	9.8	9.9	9.5
250	8.7	8.6	8.6
300	7.8	7.8	7.9
400	6.6	6.5	6.5
ILD	30	30	15
T	15.4	15.4	15.2
SLD	100	90	103

Table D-1, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	1615	1800	1830	1930	2030	2052
0	15.6	15.3	15.3	15.3	15.4	15.3
10	15.5	15.2	15.2	15.3	15.3	15.3
20	15.4	15.1	15.0	15.2	15.2	15.2
30	15.4	15.1	15.0	15.2	15.1	15.2
50	15.4	15.0	15.0	15.1	15.0	15.0
75	15.1	14.9	14.9	15.1	15.0	15.0
100	14.8	14.7	14.7	14.3	14.9	14.6
125	13.9	13.8	13.7	13.3	13.3	13.3
150	12.4	12.5	12.5	11.8	12.0	11.9
200	10.0	10.3	10.2	9.7	9.7	9.7
ILD	11	11	11	11	17	11
T	15.5	15.2	15.3	15.3	15.3	15.3
SLD	101	101	107	85	101	96

Table D-2. Computed Sound-Speed Profiles (m/sec), Station 3 Run 4 (20 February 1972 1531-2052 LST).

XBT MEASUREMENTS

Depth, m	209L 1535	210L 1555	212L 1637	213L 1651	214L 1708	215L 1725	216L 1747	217L 1900
0	1507.2	1507.6	1507.2	1507.2	1506.9	1506.9	1506.9	1506.3
10	07.1	07.4	07.1	07.1	06.8	07.1	07.1	06.4
20	06.9	07.6	07.2	06.6	06.6	07.2	06.6	06.6
30	07.1	07.4	07.4	06.8	06.8	06.8	06.8	06.5
50	07.4	07.4	07.1	07.1	07.1	06.8	06.8	06.5
75	06.9	07.9	06.9	06.6	06.6	06.6	06.9	06.6
100	06.5	06.8	06.8	06.8	06.8	06.5	06.8	06.5
125	01.9	02.3	04.0	04.7	03.3	03.0	02.3	02.6
150	1498.6	1499.0	1499.7	00.7	01.1	1499.0	1499.3	1497.9
200	91.2	91.6	91.9	1493.0	1493.0	92.3	91.6	91.2
250	88.6	89.4	88.6	89.4	89.7	89.0	89.4	89.0
300		86.2	86.2	86.9	87.7	86.9	86.5	85.8
400		82.9	93.7	83.7	84.1	83.3	83.3	83.7
SC	0	9	0	0	0	20	10	20
DC	20	12	10	20	20		20	40
MAX	45	20	30	50	58		75	66
DC		40		75	75			
MAX		75		110	109			

Depth, m	218L 2000	112D 1600	113D 1800	114D 2000
0	1506.9	1506.6	1506.6	1506.0
10	07.1	06.8	06.8	06.4
20	06.6	06.9	06.9	06.9
30	06.5	07.1	07.1	07.1
50	06.8	06.8	06.5	07.1
75	06.9	06.2	06.2	06.2
100	06.5	06.1	04.1	04.4
125	01.6	00.9	00.6	00.9
150	1497.9	1496.9	1496.9	1496.5
200	90.5	91.2	91.6	90.1
250	87.8	88.2	87.8	87.8
300	84.6	85.8	85.8	86.2
400	82.9	82.9	82.4	82.4
SC	15	30	30	50
DC	30			
MAX	80			

Table D-2, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	1615	1800	1830	1830	2030	2052
0	1507.1	1506.2	1506.2	1506.3	1506.4	0506.3
10	07.1	06.0	06.2	06.3	06.5	06.5
20	06.9	06.0	95.7	06.2	06.3	06.4
30	07.1	06.1	05.8	06.4	06.0	06.4
50	07.4	06.2	06.0	06.5	06.3	06.3
75	07.0	06.4	06.1	06.9	06.6	06.6
100	06.4	06.1	06.1	04.6	06.7	05.8
125	03.9	03.6	03.3	01.8	02.0	01.9
150	1499.4	1499.6	1499.6	1497.1	1497.8	1497.4
200	92.0	93.1	92.8	90.8	90.9	90.9
SC	11	0	11	11	17	11
DC	20	15	20	20	30	50
MAX	50	75	75	75	101	96

Table D-3. Average Sound-Speed Profile (m/sec), Station 3 Run 4 (20 February 1972 1531-2052 LST).

Depth, m	Number of Observations	Average Speed	Standard Deviation
0	1944	1506.44	0.35
10	1944	06.47	0.35
20	1944	06.38	0.39
30	1944	06.33	0.42
50	1944	06.42	0.39
75	1944	06.51	0.33
100	1944	06.20	0.61
125	1944	02.86	0.93
150	1944	1498.95	1.02
200	1944	91.92	0.72
250	1944	88.98	0.50
300	15	86.14	0.74
400	15	83.13	0.47
500	9	81.81	0.29
600	5	81.36	0.36
800	4	81.25	0.15
1000	4	82.17	0.22
1200	4	83.47	0.22
1500	4	86.06	0.22
10		1506.47	SC
30		1506.33	DC
96		1506.80	MAX
700		1481.20	AXIS

Table D-4. Average Thermistor Chain Temperatures, Station 3 Run 4 (number of measurements at each depth: 1944).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.07	15.62	15.35	0.114
6	15.07	15.60	15.34	0.108
11	15.00	15.55	15.30	0.112
17	14.97	15.55	15.25	0.116
23	14.95	15.50	15.21	0.118
28	14.92	15.47	15.18	0.120
34	14.87	15.42	15.13	0.125
39	14.90	15.45	15.14	0.128
45	14.87	15.45	15.11	0.126
51	14.82	15.40	15.07	0.123
56	14.85	15.42	15.09	0.119
62	14.77	15.37	15.06	0.115
68	14.77	15.35	15.01	0.109
73	14.75	15.25	14.98	0.095
79	14.75	15.15	14.96	0.084
85	14.62	15.07	14.90	0.083
90	14.55	15.05	14.84	0.094
96	14.37	15.00	14.79	0.104
101	14.02	14.95	14.67	0.183
107	13.97	14.92	14.52	0.204
113	13.82	14.77	14.28	0.220
118	13.17	14.60	13.95	0.240
124	13.10	14.30	13.60	0.267
130	12.62	13.92	13.30	0.263
135	12.35	13.62	12.99	0.268
141	11.97	13.22	12.73	0.275
147	11.77	13.02	12.48	0.300
152	11.32	12.72	12.12	0.293
158	10.92	12.37	11.83	0.293
164	10.77	12.15	11.48	0.360
169	10.47	11.82	11.16	0.366
175	10.27	11.60	10.91	0.354
180	10.02	11.25	10.62	0.295
186	9.87	11.02	10.40	0.266
192	9.77	10.80	10.24	0.238
197	9.67	10.50	10.07	0.211
203	9.57	10.30	9.93	0.197
209	9.37	10.20	9.73	0.173
214	9.32	9.95	9.57	0.140
220	9.22	9.80	9.45	0.092
226	9.07	9.57	9.34	0.097
231	8.92	9.50	9.21	0.110
237	8.87	9.42	9.13	0.123
242	8.77	9.30	9.02	0.127

Table D-5. Standard Deviation (cm) of Wave Height for 3-min Averages, Station 3 Run 4 (20 February 1972 1531-2052 LST).

	Hours					
Minutes	1500	1600	1700	1800	1900	2000
01		49	37		50	80
04		41	51	54	48	46
07		35	41	50	36	60
10		52	79	76	39	50
13		56	68	48	52	49
16		54	50	45	37	40
19		56	50	53	60	80
22		36	36	47	52	63
25		59	55	47	54	65
28		45	60	67	51	60
31	74	52	55	73	37	69
34	79	50	57	61	59	65
37	50	61	45	61	43	63
40	56	58	48	59	58	46
43	52	36	62	77	41	40
46	41	52	44	45	50	40
49	42	54	69	45	53	41
52	45	59	50	65	43	
55	52	45	38	50	35	
38	75	47	55	57	46	

Table D-6. Standard Deviation of Wave Height as a Function of Wave Period, Station 3 Run 4 (20 February 1972).

1531-1800 LST

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
1.2 – 1.4	4.4	8.0 – 8.4	4.6
1.5 – 1.9	6.1	8.5 – 9.0	4.3
2.0 – 2.4	5.7	9.1 – 9.5	5.3
2.5 – 2.9	5.8	9.6 – 10.0	6.1
3.0 – 3.4	5.4	10.1 – 10.6	10.3
3.5 – 3.9	6.2	10.7 – 11.3	10.8
4.0 – 4.4	6.4	11.4 – 12.1	16.3
4.5 – 4.9	4.2	12.2 – 13.0	21.6
5.0 – 5.4	3.2	13.1 – 14.1	25.4
5.5 – 5.9	3.3	14.2 – 15.4	22.2
6.0 – 6.4	2.9	15.5 – 16.8	13.7
6.5 – 6.9	3.6		
7.0 – 7.4	4.0		
7.5 – 7.9	2.8		

1804-2052 LST

1.2 – 1.4	3.3	8.0 – 8.4	3.2
1.5 – 1.9	4.8	8.5 – 8.8	4.0
2.0 – 2.4	4.7	8.9 – 9.3	4.9
2.5 – 2.9	4.7	9.4 – 9.8	6.6
3.0 – 3.4	4.7	9.9 – 10.4	9.1
3.5 – 3.9	5.4	10.5 – 11.1	11.6
4.0 – 4.4	5.1	11.2 – 11.8	14.9
4.5 – 4.9	4.0	11.9 – 12.7	21.7
5.0 – 5.4	2.8	12.8 – 13.7	30.9
5.5 – 5.9	2.7	13.8 – 14.9	21.9
6.0 – 6.4	2.3	15.0 – 16.1	12.6
6.5 – 6.9	2.3		
7.0 – 7.4	2.8		
7.5 – 7.9	3.9		

APPENDIX E

STATION 3 RUN 5

DETAILED ENVIRONMENTAL DATA SUMMARY

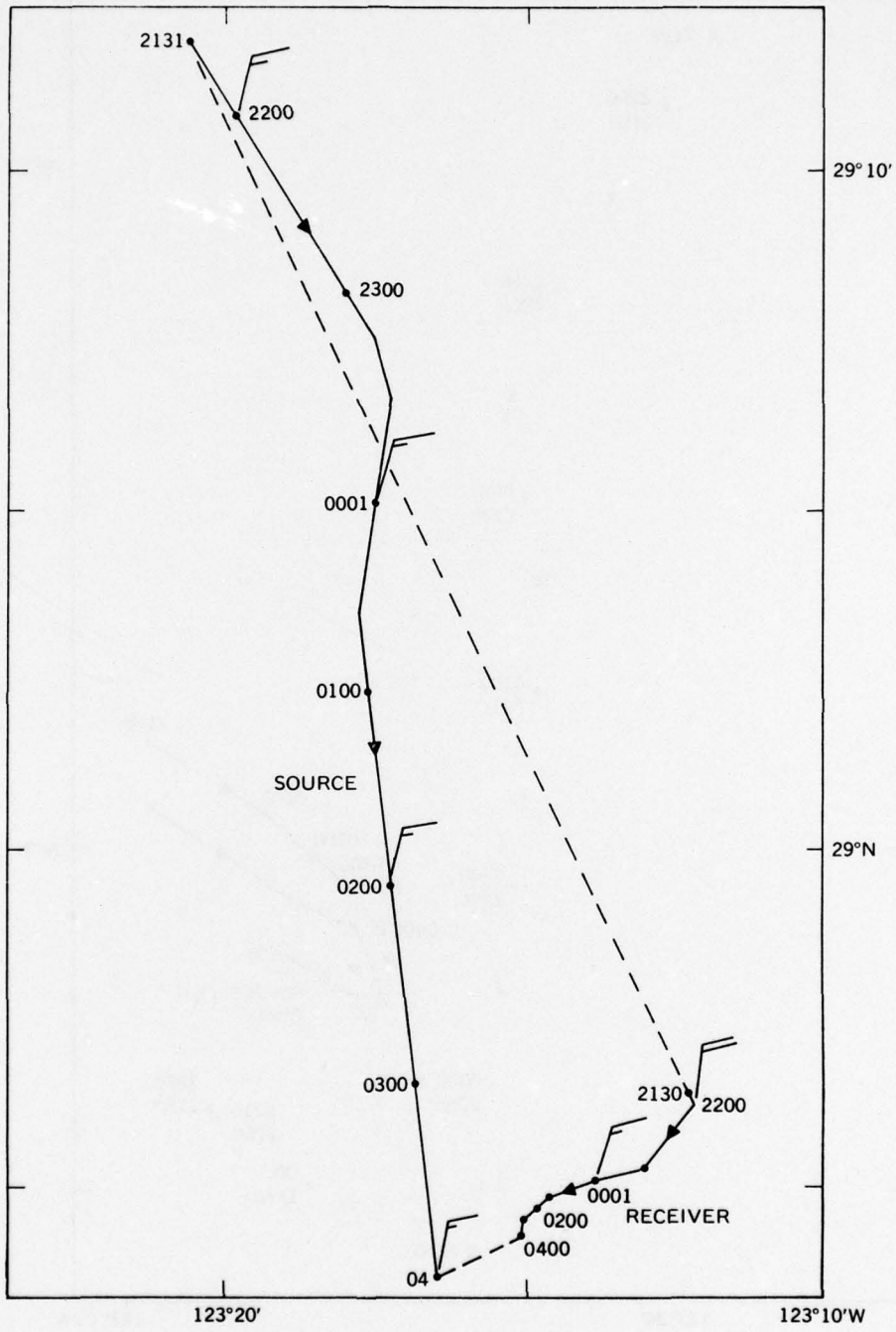

Figure E-1. Station 3, run 5. Location of source and receiver ships, 2131 and 0400 LST propagation paths (---), and wind velocity (●——⫽ 10-knot east wind, 1 bar = 5 knots).

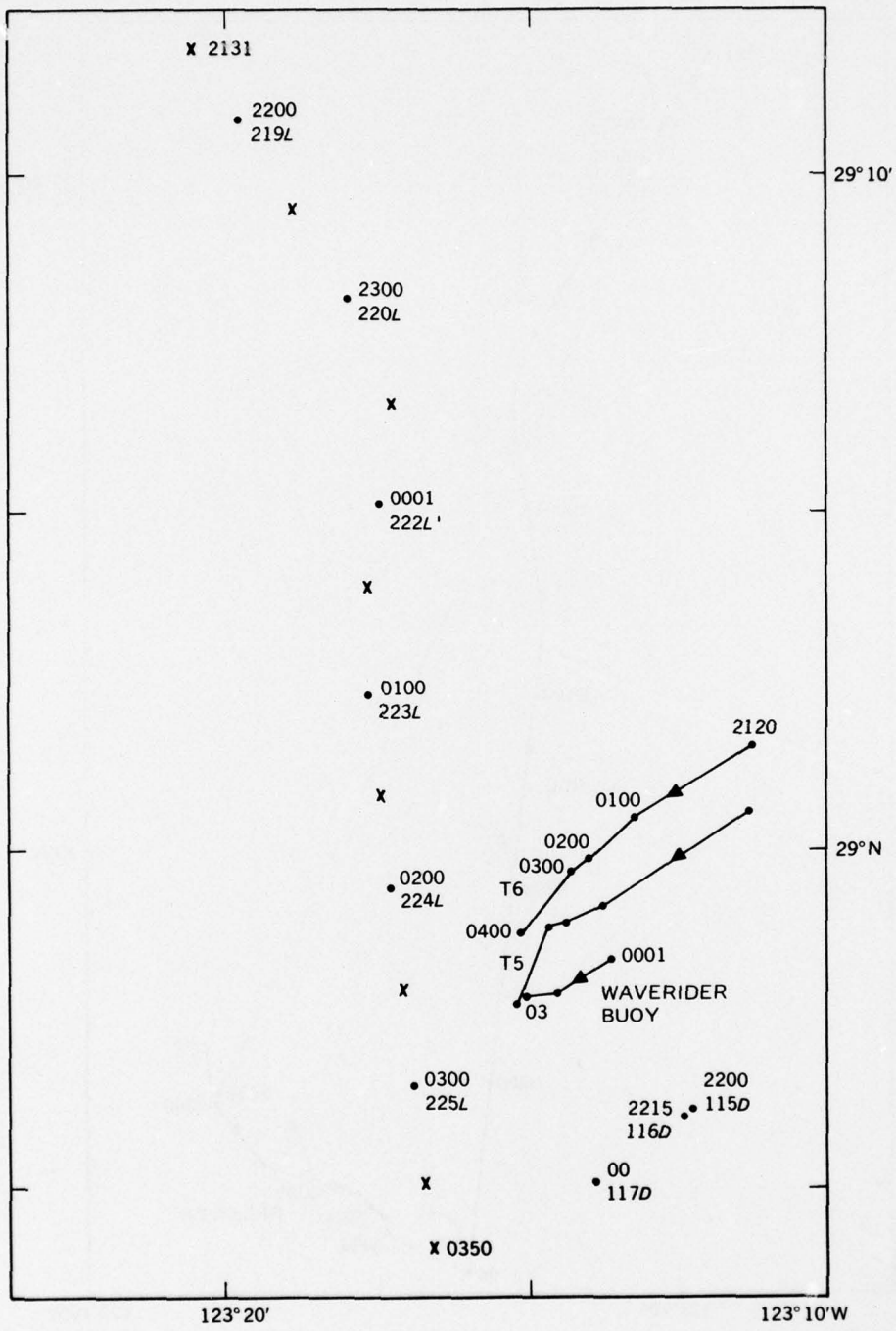

Figure E-2. Station 3, run 5. Location of XBT (·), thermistor chain (X), and Teletherm buoy (T), and Waverider buoy measurements. The letter following the XBT number denotes the ship which took the measurement *(L: Lee, D: DeSteiguer)*. Times shown are LST.

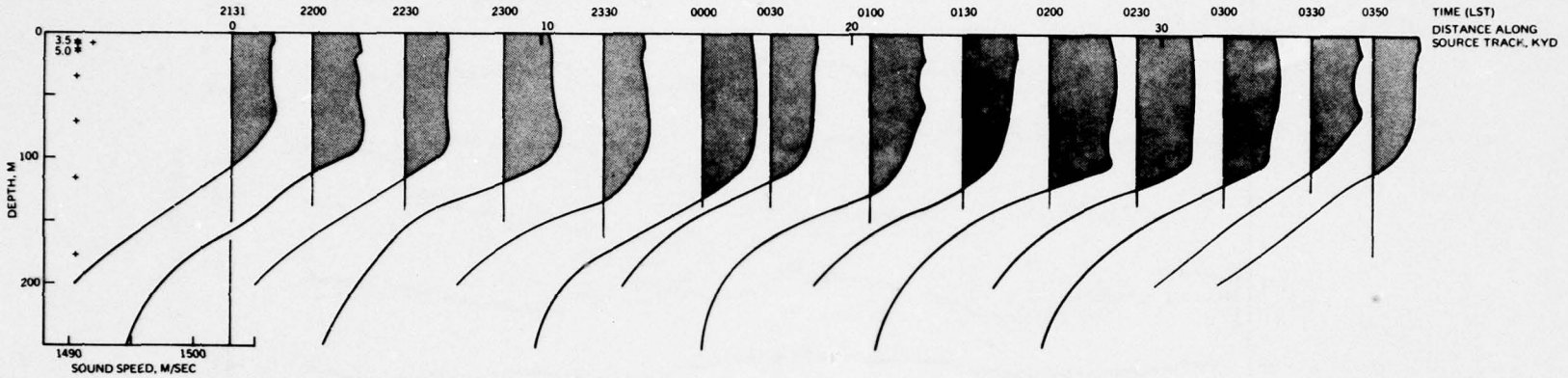

Figure E-3. Station 3, run 5. Sound-speed profiles along track of source ship derived from XBT and thermistor chain data. Source depth (*), receiver depths (+).

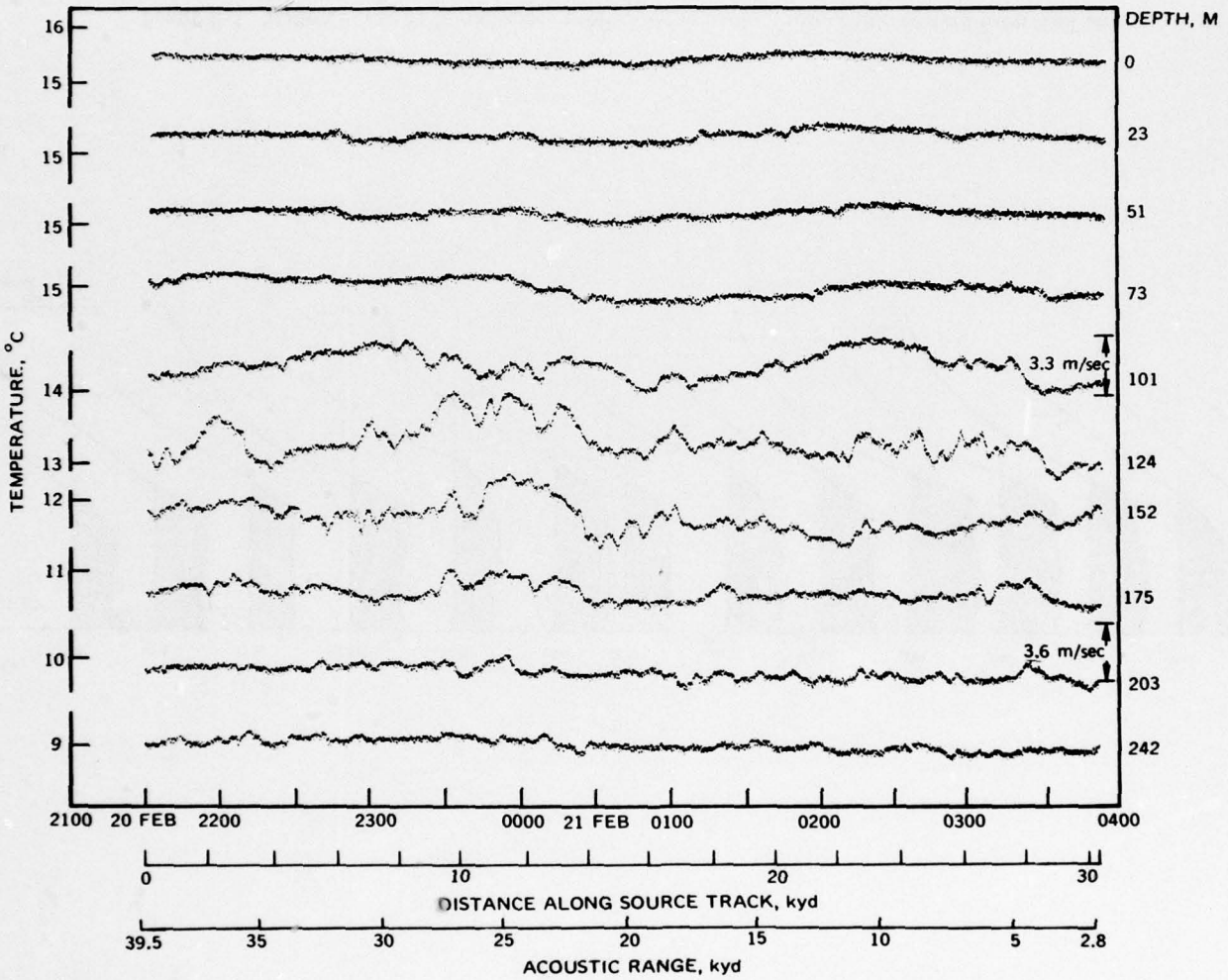

Figure E-4. Station 3, run 5. Thermistor chain temperature measurements at selected depths. Time is LST.

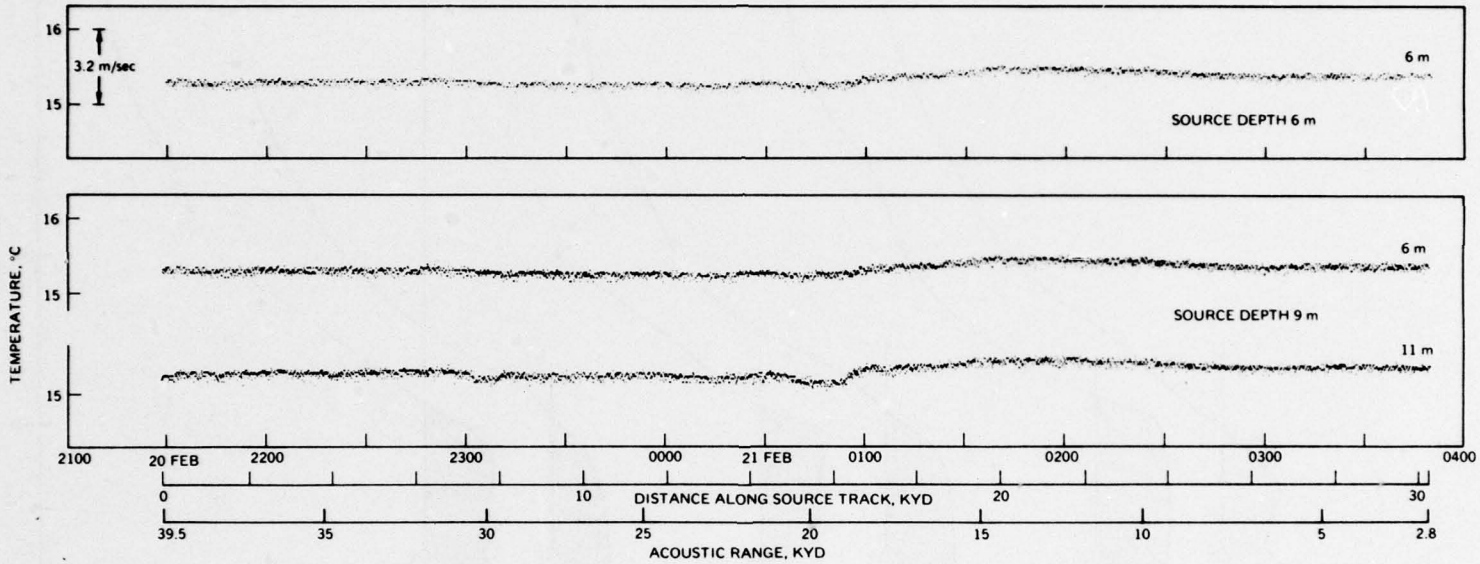

Figure E-5. Station 3, run 5. Temperatures at or above and below source. Time is LST.

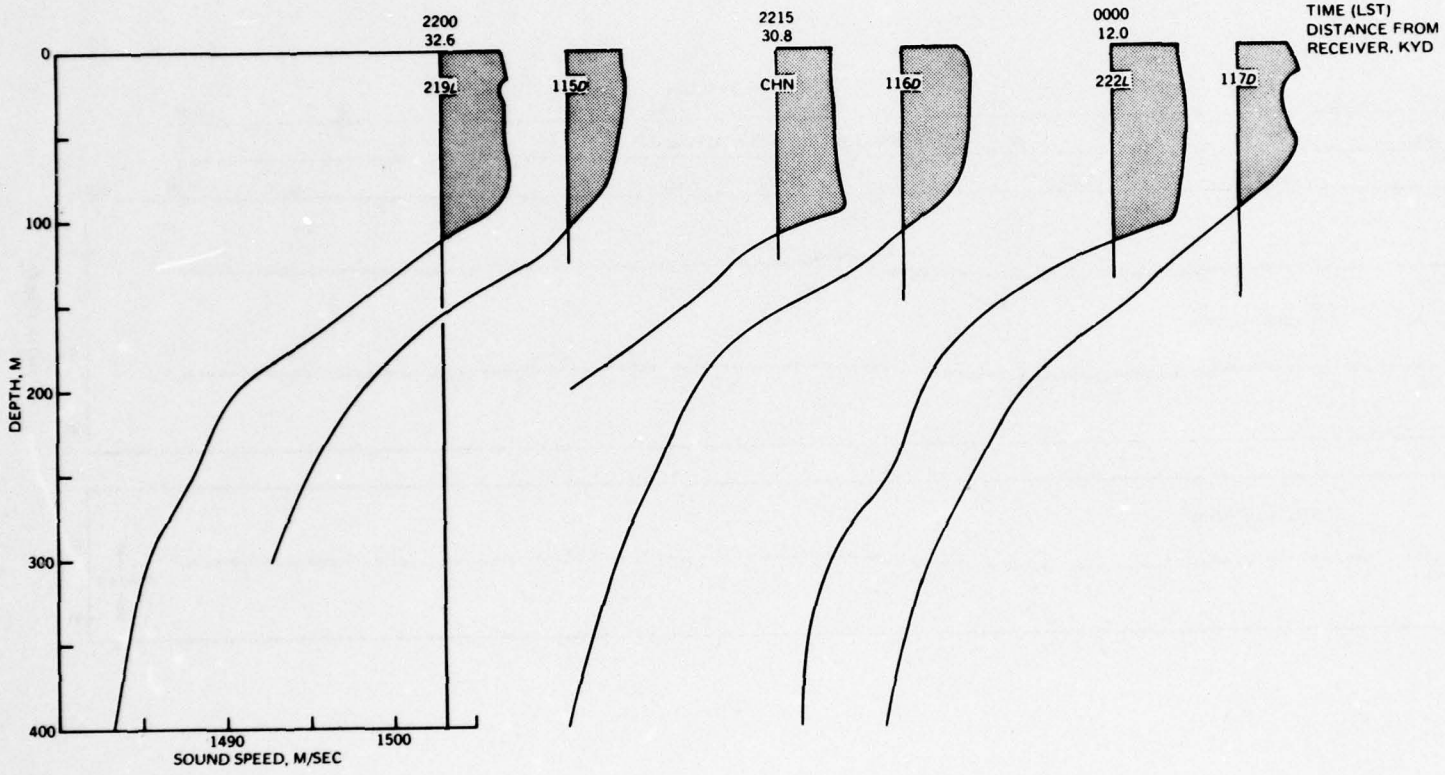

Figure E-6. Station 3, run 5. Spatial change in sound-speed profiles.

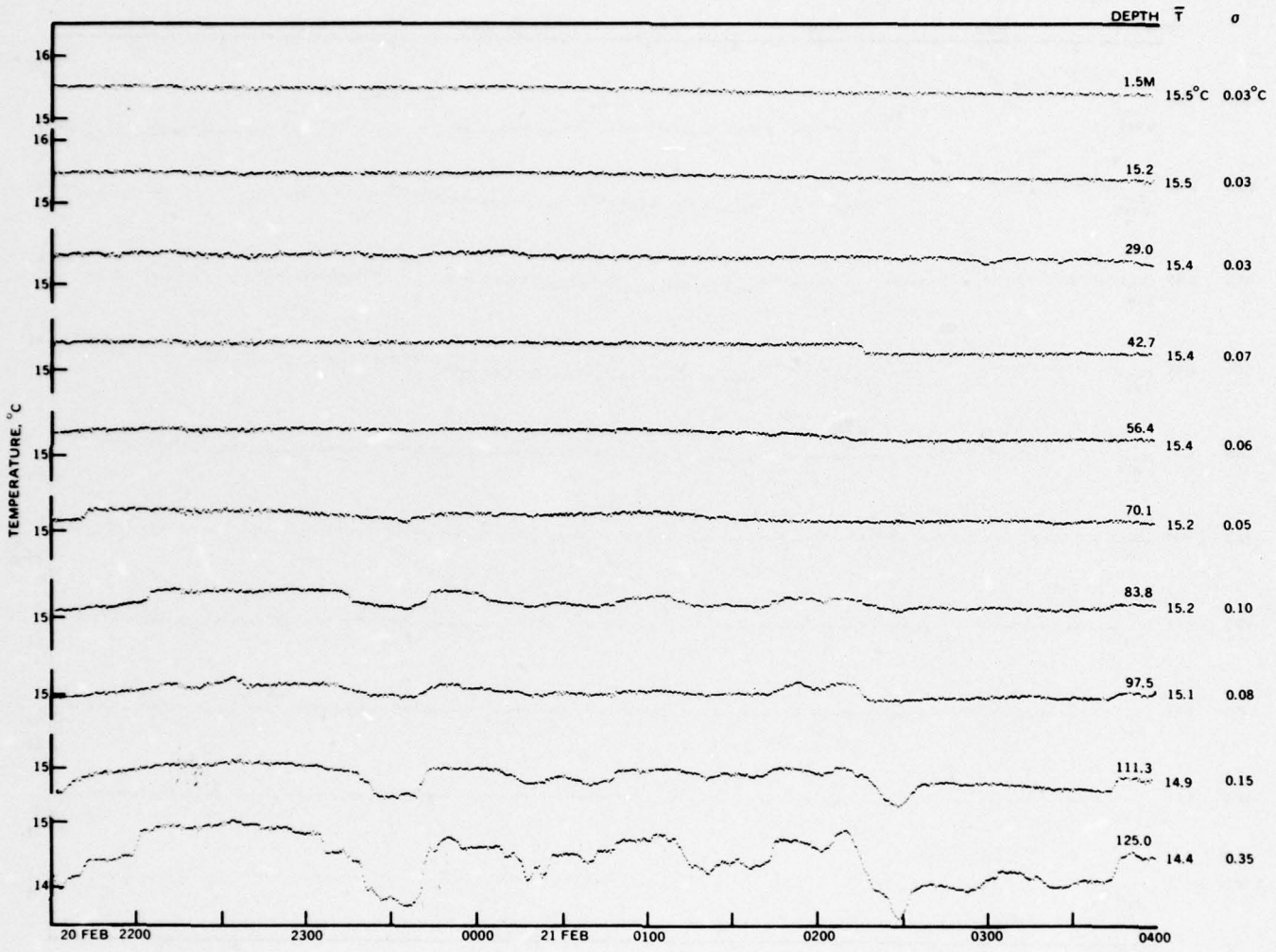

Figure E-7a. Station 3, run 5. Teletherm buoy 5 temperature measurements (n = 2254). Time is LST.

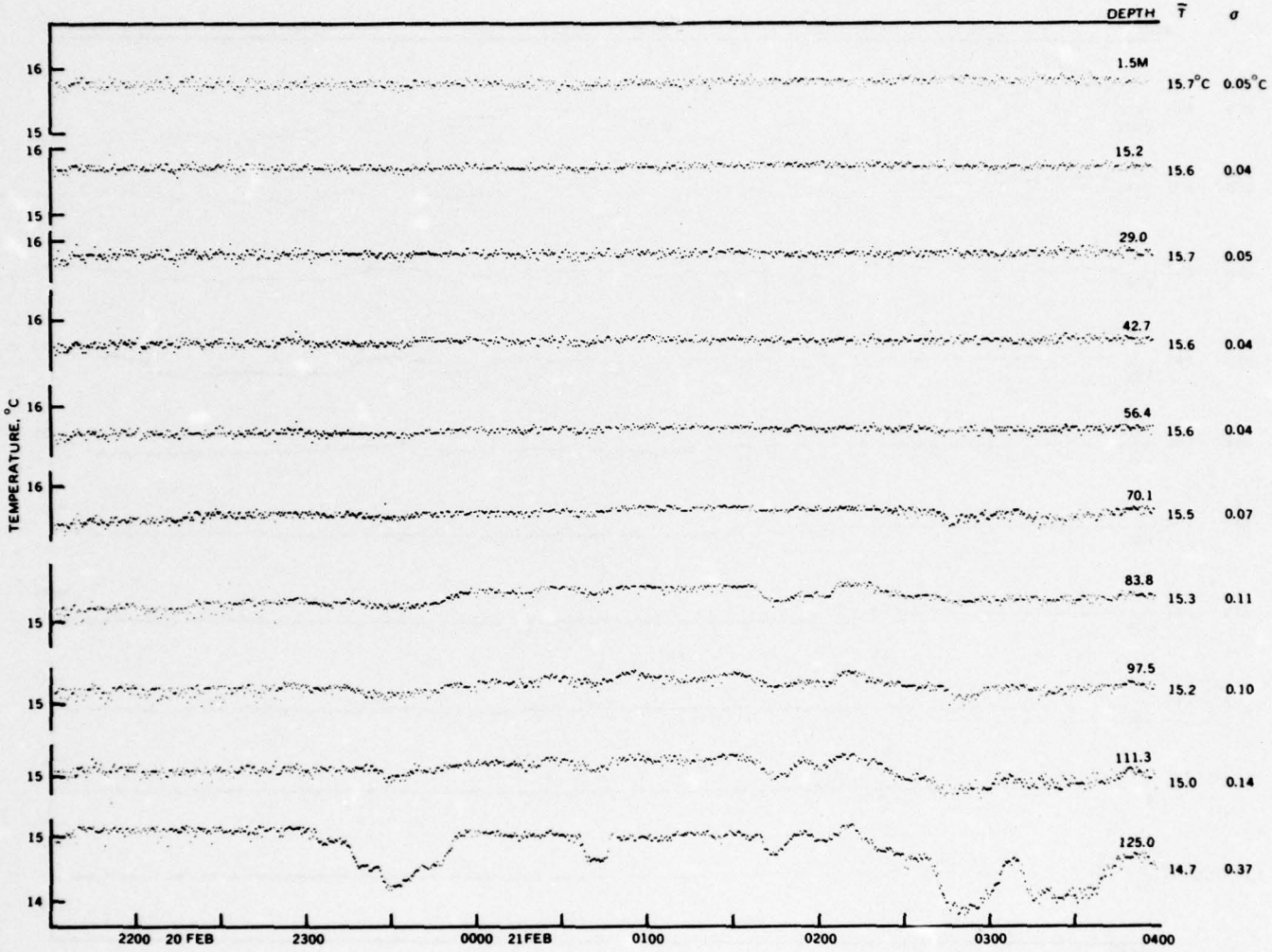

Figure E-7b. Station 3, run 5. Teletherm buoy 6 temperature measurements (n = 2082). Time is LST.

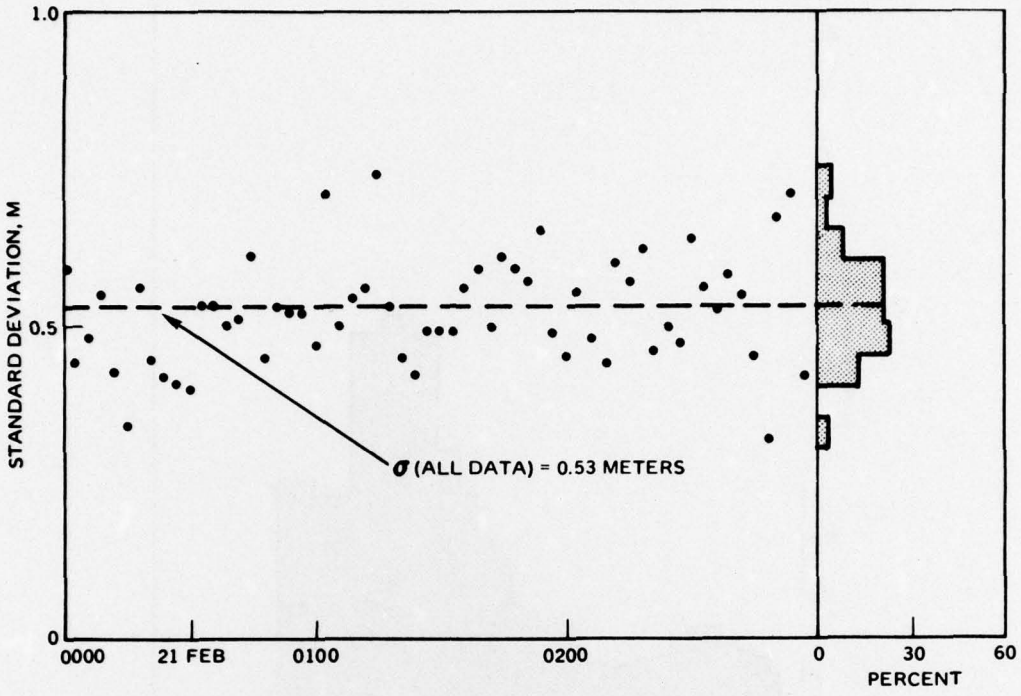

Figure E-8. Standard deviation of surface-wave height for 3-min averages. Time is LST.

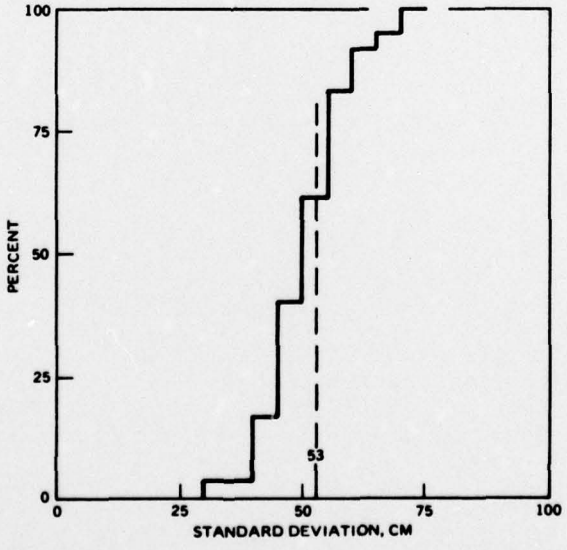

Figure E-9. Station 3, run 5. Ogive of standard deviation of surface-wave height for 3-min averages.

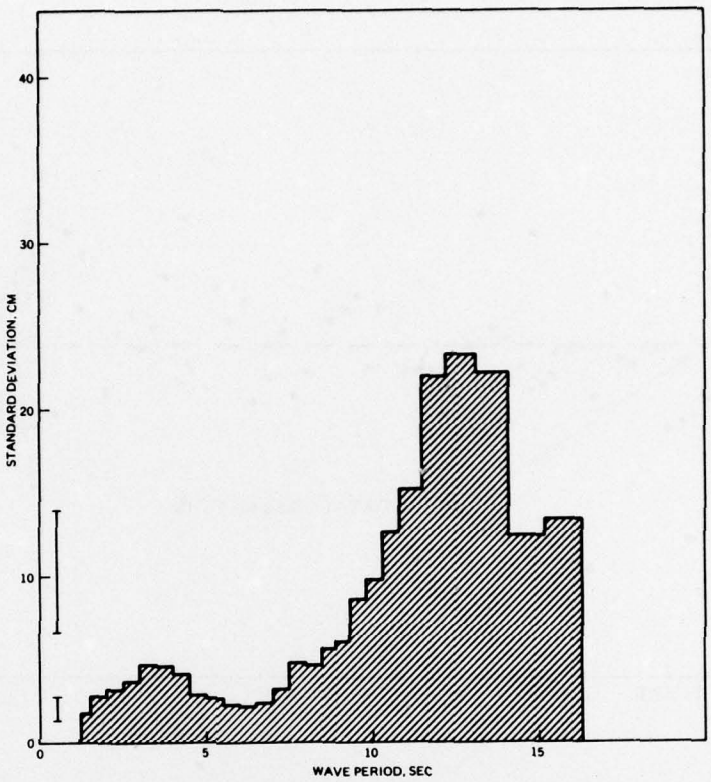

Figure E-10. Station 3, run 5. Standard deviation of wave height as a function of wave period (21 February 1972, 0001-0300 LST).

Table E-1. Temperature Profiles (°C),
Station 3 Run 5 (20-21 February 1972 2131-0400 LST).

XBT MEASUREMENTS

Depth, m	219L 2200	220L 2300	222L 0003	223L 0100	224L 0200	225L 0300	115D 2200	115D 2215	117D 0000
0	15.4	15.4	15.5	15.4	15.6	15.5	15.3	15.3	15.2
10	15.4	15.4	15.5	15.4	15.6	15.5	15.3	15.5	15.3
20	15.3	15.4	15.5	15.4	15.6	15.5	15.3	15.5	15.1
30	15.3	15.3	15.5	15.2	15.6	15.5	15.2	15.4	15.0
50	15.2	15.3	15.4	15.2	15.5	15.4	15.0	15.3	15.0
75	15.2	15.3	15.2	14.9	15.2	15.1	14.7	15.0	14.7
100	14.4	14.9	14.9	14.4	15.1	14.8	13.9	14.1	13.7
125	13.0	13.3	13.9	13.6	13.2	13.3	13.0	13.0	12.5
150	12.0	11.4	12.6	11.7	11.5	11.8	11.5	11.6	11.3
200	9.7	9.9	9.9	9.6	9.7	9.8	9.7	9.6	9.5
250	8.7	8.8	9.1	8.9	8.8	8.8	8.5	8.7	8.4
300	7.7	7.7	7.9	7.9	8.0	7.9	7.7	7.8	7.5
400	6.7	6.8	6.9	6.8	6.9	6.7		6.6	6.3
ILD	18	20	30	20	28	40	20	28	15
T	15.4	15.4	15.5	15.4	15.6	15.5	15.3	15.4	15.3
SLD	90	100	90	90	105	102	85	83	62

THERMISTOR CHAIN MEASUREMENTS

Depth, m	2131	2230	2330	0030	0130	0230	0330	0350
0	15.3	15.4	15.3	15.3	15.4	15.5	15.4	15.4
10	15.3	15.3	15.3	15.3	15.4	15.4	15.4	15.4
20	15.1	15.2	15.2	15.1	15.3	15.4	15.3	15.3
30	15.2	15.2	15.2	15.1	15.2	15.4	15.2	15.2
50	15.1	15.1	15.1	15.0	15.1	15.3	15.2	15.1
75	14.9	15.0	15.0	14.7	14.8	15.1	14.8	14.9
100	14.1	14.5	14.7	14.4	14.4	14.9	14.1	14.3
125	12.8	13.1	14.0	13.0	13.2	13.3	12.8	12.9
150	11.8	11.8	12.2	11.3	11.7	11.5	11.7	11.9
200	9.6	9.7	9.8	9.6	9.6	9.7	9.6	9.6
ILD	6	11	11	11	17	45	17	11
T	15.3	15.3	15.3	15.3	15.4	15.4	15.4	15.4
SLD	85	90	90	101	62	101	85	62

Table E-2. Computed Sound Profiles (m/sec),
Station 3 Run 5 (20-21 February 1972 2131-0400 LST).

XBT MEASUREMENTS

Depth, m	219L 2200	220L 2300	222L 0000	223L 0100	224L 0200	225L 0300
0	1506.6	1506.6	1506.9	1506.6	1507.2	1506.9
10	06.8	06.8	07.1	06.8	07.4	07.1
20	06.6	06.9	07.2	06.9	07.6	97.2
30	06.8	06.8	07.4	06.5	07.7	07.4
50	06.8	07.1	07.4	06.8	07.8	07.4
75	07.2	07.6	07.2	06.2	07.2	06.9
100	05.1	06.8	06.8	05.1	07.5	06.5
125	00.9	01.9	04.0	03.0	01.6	01.9
150	1497.9	1495.8	00.0	1496.9	1496.2	1497.2
200	90.8	91.6	1491.6	90.5	90.8	91.2
250	88.2	88.6	89.7	89.0	88.6	88.6
300	85.4	85.4	86.2	86.2	86.5	86.2
400	83.3	83.7	84.1	83.7	84.1	83.3
SC	18	20	60	20	50	50
DC	20	30		30	85	
MAX	75	75		60	105	

Depth, m	115D 2200	116D 2215	117D 0000
0	1506.3	1506.3	1506.0
10	06.4	07.1	06.4
20	06.6	07.2	06.0
30	06.5	07.1	05.8
50	06.2	07.1	06.2
75	05.6	06.6	05.6
100	03.4	04.1	02.7
125	00.9	00.9	1499.2
150	1496.2	1496.5	96.5
200	90.8	90.5	90.1
250	87.5	88.2	87.1
300	85.4	85.8	84.6
400		82.9	81.6
SC	20	28	15
DC			30
MAX			62

Table E-2, continued.

THERMISTOR CHAIN MEASUREMENTS

Depth, m	2131	2230	2330	0030	0130	0230	0330	0350
0	1506.3	1506.4	1506.1	1506.2	1506.7	1506.8	1506.6	1506.6
10	06.3	06.5	06.3	06.3	06.8	06.8	06.9	06.7
20	06.1	06.4	06.2	06.0	06.6	07.0	06.6	06.5
30	06.3	06.4	06.4	06.0	06.6	07.1	06.5	06.5
50	06.4	06.5	06.6	06.0	06.5	07.2	06.8	06.4
75	06.1	06.5	06.7	05.7	05.9	06.8	06.0	06.1
100	04.1	05.5	06.0	05.1	05.0	06.7	04.1	04.6
125	00.3	01.2	04.3	00.9	01.9	01.9	00.3	00.5
150	1497.1	1497.3	1498.5	1495.6	1496.7	1496.2	1496.9	1497.5
200	90.5	91.0	91.3	90.6	90.6	91.0	90.6	90.6
SC	6	11	11	11	17	50	17	11
DC	20		20				30	
MAX	62		90				62	

Table E-3. Average Sound-Speed Profile (m/sec), Station 3 Run 5 (20-21 February 1972 2131-0400 LST).

Depth, m	Number of Observations	Average Speed	Standard Deviation
0	2286	1506.51	0.26
10	2286	06.54	0.29
20	2286	06.44	0.32
30	2286	06.46	0.32
50	2286	06.51	0.29
75	2286	06.38	0.47
100	2286	05.43	0.78
125	2286	01.77	1.04
150	2286	1497.13	0.84
200	2286	90.92	0.39
250	2286	88.33	0.32
300	13	85.78	0.55
400	12	83.20	0.66
500	9	81.81	0.29
600	5	81.36	0.36
800	4	81.25	0.15
1000	4	82.17	0.22
1200	4	83.47	0.22
1500	4	86.06	0.22
10		1506.54	SC
20		1506.44	DC
50		1506.51	MAX
700		1481.20	AXIS

Table E-4. Average Thermistor Chain Temperatures, Station 3 Run 5 (number of measurements at each depth: 2286).

Depth, m	Temperature, °C Min	Max	Mean	Standard Deviation
0	15.15	15.52	15.34	0.077
6	15.15	15.52	15.34	0.076
11	15.07	15.52	15.32	0.090
17	15.02	15.52	15.27	0.113
23	14.97	15.50	15.23	0.103
28	14.97	15.45	15.21	0.096
34	14.95	15.40	15.16	0.097
39	14.95	15.45	15.17	0.098
45	14.87	15.42	15.14	0.096
51	14.85	15.37	15.11	0.093
56	14.80	15.35	15.09	0.090
62	14.70	15.25	15.06	0.096
68	14.62	15.20	14.99	0.118
73	14.60	15.17	14.94	0.135
79	14.57	15.15	14.91	0.129
85	14.47	15.15	14.84	0.138
90	14.22	15.10	14.74	0.180
96	14.12	15.00	14.64	0.197
101	13.92	14.95	14.41	0.233
107	13.75	14.82	14.20	0.203
113	13.30	14.55	13.96	0.223
118	12.90	14.32	13.66	0.300
124	12.70	14.17	13.31	0.303
130	12.42	13.80	12.92	0.238
135	12.05	13.25	12.61	0.199
141	11.67	12.80	12.30	0.223
147	11.32	12.72	11.99	0.262
152	10.97	12.40	11.61	0.239
158	10.75	12.12	11.32	0.262
164	10.52	11.70	10.98	0.225
169	10.37	11.32	10.73	0.188
175	10.25	10.92	10.53	0.138
180	9.97	10.72	10.35	0.135
186	9.80	10.55	10.11	0.124
192	9.72	10.30	9.95	0.104
197	9.52	10.10	9.78	0.096
203	9.37	9.95	9.66	0.090
209	9.22	9.75	9.52	0.111
214	9.12	9.65	9.40	0.121
220	9.02	9.57	9.32	0.119
226	8.92	9.50	9.22	0.129
231	8.82	9.37	9.11	0.116
237	8.82	9.27	9.03	0.090
242	8.72	9.12	8.93	0.077

Table E-5. Standard Deviation (cm) of Wave Height for 3-Min Averages, Station 3 Run 5 (21 February 1972 0000-0200 LST).

Minutes	Hours 0000	0100	0200
00	59	47	45
03	44	71	55
06	48	50	48
09	55	54	44
12	43	56	60
15	34	74	57
18	56	53	62
21	45	45	46
24	42	42	50
27	41	49	47
30	40	49	64
33	53	49	56
36	53	56	52
39	50	59	58
42	51	50	55
45	61	61	45
48	45	59	32
51	53	57	67
54	52	65	71
57	52	49	42

Table E-6. Standard Deviation of Wave Height as a Function of Wave Period, Station 3 Run 4 (21 February 1972 0000-0300 LST).

Wave-Period Band, sec	Standard Deviation, cm	Wave-Period Band, sec	Standard Deviation, cm
1.2 – 1.4	1.8	7.5 – 7.9	4.8
1.5 – 1.9	2.8	8.0 – 8.4	4.6
2.0 – 2.4	3.2	8.5 – 8.8	5.7
2.5 – 2.9	3.7	8.9 – 9.2	6.1
3.0 – 3.4	4.7	9.3 – 9.7	8.6
3.5 – 3.9	4.6	9.8 – 10.2	9.8
4.0 – 4.4	4.1	10.3 – 10.7	12.7
4.5 – 4.9	2.9	10.8 – 11.4	15.2
5.0 – 5.4	2.7	11.5 – 12.1	22.0
5.5 – 5.9	2.3	12.2 – 13.0	23.3
6.0 – 6.4	2.2	13.1 – 14.0	22.3
6.5 – 6.9	2.4	14.1 – 15.1	12.4
7.0 – 7.4	3.2	15.2 – 16.3	13.4